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ARGONNE CODE CENTER:
COMPILATION OF PROGRAM ABSTRACTS

by

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NO.	NWIC TITLE	INSTALLATION	MACH	LANG	PACKAGE	
7	FIRN, 2-D FEW-GP S4 APPROXIMATION RZ GEOMETRY	LRL	709	F2	RS	23
9	FIRE2, 1-D AGE-DIFFUSION SLAB CYLINDER SPHERE	RGA	360	F4	RS PLT	24
14	HAFTER, PAUSER-FESBACH INELASTIC SCATTERING	CDC	1604	F63	RS P	26
18	2DXY, 2-D MULTI-GP SN APPROXIMATION XY GEOM	AGN	7090	FLOCC	RSBP	28
28	FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE	AI	7090	F2	RS P T	30
28	FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE	CDC	1604	F63	RS P T	30
29	AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	AI	7090	F+FAP	RS PLT	32
29	AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	CDC	1604	F63	RS PLT	32
30	PERT, 1-D PERTURBATION FOR AIM AND FOG CODES	AI	7090	F2	RS	34
30	PERT, 1-D PERTURBATION FOR AIM AND FOG CODES	CDC	1604	F63	RS	34
30	PERT, 1-D PERTURBATION FOR AIM AND FOG CODES	BOEC	360	F4	RS P	34
32	WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY	ORNL	7090	F2	RS P T	36
32	WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY	CDC	1604	F63	RS P T	36
33	GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC	GA	7090	F2	RS PLT	38
33	GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC	CDC	1604	F63	RS PLT	38
39	EQUIPOISE3, 2-D 2-GROUP DIFFUSION SLAB CYL	ORNL	7090	F2	RS P T	40
40	ZOGRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER	ORNL	7090	F2	RS P T	42
40	ZOGRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER	CDC	1604	F63	RS P T	42
41	ZUT, RESOLVED REGION RESONANCE INTEGRAL CALC	GA	7090	F+FAP	RSB T	44
42	TLZ, UNRESOLVED REGION RESONANCE INTEGRAL CALC	GA	7090	F+FAP	RSB T	46
45	GRACE1, GAMMA-RAY ATTENUATION SLAB GEOMETRY	AI	7090	F2	RS P	48
45	GRACE1, GAMMA-RAY ATTENUATION SLAB GEOMETRY	CDC	1604	F63	RS P	48
46	GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE GEOM	AI	7090	F2	RS P	50
46	GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE GEOM	CDC	1604	F63	RS P	50
47	CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD	AI	7090	F2	RS P	52
47	CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD	CDC	1604	F63	RS P	52
47	CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD	SRL	360	F4	RS P	52
48	FUGUE, STEADY-STATE TEMPERATURE VOID FRACTION	AI	7090	F2	RS	54
50	TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS	AI	7090	F+FAP	RS PLT	56
50	TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS	CDC	1604	F63	RS PLT	56
50	TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS	BOEC	360	F4	RS PLT	56
51	FORM, FAST NEUTRON SPECTRUM X-SECTION CALC	AI	7090	F2	RS PLT	58
51	FORM, FAST NEUTRON SPECTRUM X-SECTION CALC	CDC	1604	F63	RS PLT	58
52	SAIL, 1-D 1-GP SN APPROXIMATION SLAB GEOMETRY	AI	7090	F2	RS	60
53	S4 CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION	AI	7090	F2	RS	62

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NO.	KMC TITLE	INSTALLATION	MACH	LANG	PACKAGE	
53	S4 CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION	CDC	1604	F63	RS	62
55	A1MFIRE, URANIUM FUEL CYCLE COST ANALYSIS	AI	7090	F2	RS P	64
56	SLPMT, CRYSTALLINE SCATTERING KERNEL CALC	GA	7090	F2	RS T	66
58	SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION	AI	7090	F2	RS LT	68
58	SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION	CDC	1604	F63	RS LT	68
58	SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION	AI	360	F4	RSBP T	68
59	MIST, 1-D FEW-GP SN DOUBLE SN APPROX SLAB GEOM	PP	7090	F2	RS P	70
62	LASL LEAST SQUARES, GENERAL CURVE FITTING	LASL	7094	F4	RS	72
75	GE-FAPO-S13, 1-D MULTI-GP DOUBLE SN APPROX	BNWL	7090	FLOCC	RSBP T	74
87	EQUIPCISE3A, 2-D 2-GP DIFFUSION CYLINDER SLAB	CRNL	7090	F2	RS P T	77
87	EQUIPCISE3A, 2-D 2-GP DIFFUSION CYLINDER SLAB	CDC	1604	F63	RS P T	77
89	ARES2, RESONANCE INTEGRAL X-SECTION CALC	AI	7090	F2	RS PLT	79
89	ARES2, RESONANCE INTEGRAL X-SECTION CALC	CDC	1604	F63	RS PLT	79
91	FARSE1A, DOSE RATE FROM SNAP SHIELD LEAKAGE	AI	7090	F2	RS	81
99	DCB, 2-D FEW-GP DIFFUSION BURNUP RZ GEOMETRY	CA	7090	F+FAF	RSBP T	83
102	AX1, COUPLED NEUTRONICS-HYDRODYNAMICS SPHERE	CDC	3600	F63	RSBP	85
103	CRAM, 1-D AND 2-D MULTI-GP DIFFUSION PROGRAM	UK-R	7090	F+FAF	RSBP LT	87
108	BAM, S4 CYL CELL CODE AND TEMPEST COMBINATION	AI	7090	F2	RS P	90
109	4RESTRAINT PIPE STRESS, MAXIMUM MOMENT CALC	AI	7090	F+FAF	RS T	92
110	SCARF2, SCATTER FROM RADIATOR FINS SNAP GEOM	AI	7090	F2	RS	93
111	SCAR1, SCATTER FROM A RING SNAP GEOMETRY	AI	7090	F2	RS	95
112	CROCK, SPACE POWER PLANT DESIGN OPTIMIZATION	AI	7090	F2	RS	97
113	ZCT, GROUP-COLLAPSING OF MULTI-GP X-SECTIONS	LASL	7090	FLOCC	RS P	98
114	SHOCK, SPACE POWER PLANT DESIGN OPTIMIZATION	AI	7090	F2	RS	100
117	FEVER, 1-D FEW-GP DIFFUSION DEPLETION PROGRAM	GA	7090	F2	RSB T	101
118	ULCER, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	AI	7090	F+FAF	RS LT	103
119	CLICKIE, INFINITE MEDIUM SPECTRUM X-SECTIONS	AI	7090	F+FAF	RS LT	105
120	FAIK, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	AI	7090	F+FAF	RS LT	107
120	FAIK, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	CDC	1604	F63	RS PLT	107
120	FAIKOS, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	EDFC	360	F4	RS P T	107
121	AIREK3, SPACE-INDEPENDENT KINETICS W/FEEDBACK	AI	7090	F2	RS	110
121	AIREK3, SPACE-INDEPENDENT KINETICS W/FEEDBACK	RCA	360	F4	RS P	110
122	SNAPKINS/5A, 1-REGION KINETICS SNAP GEOMETRY	AI	7090	F2	RS	112
123	LIPRECAN1, MC NEUTRON PENETRATION CALCULATION	OAC	7090	F2	RSBP	114
129	CCNEC, COUPLED NEUTRONICS-HYDRODYNAMICS SPHERE	LRLI	7090	F2	RS P	116
132	W-DSK, 1-D MULTI-GP SN APPROX SLAB CYL SPHERE	UK-W	7090	F2	RS P T	118
133	WED, W-CSN OUTPUT TAPE EDIT REACTION RATES	UK-W	7090	F2	RS	120
134	NUCY, SOLUTION OF NUCLIDE CHAIN EQUATIONS	CRNL	7090	F2	RSBP	122
134	NUCY, SOLUTION OF NUCLIDE CHAIN EQUATIONS	CRNL	1604	F63	RSBP	122
135	TRAFICORPORATION, TRANSFER FUNCTION SYNTHESIS	ANL	3600	F63	RSBP T	124
136	HERESY1, LATTICE PARAMETERS HETEROGENEOUS CALC	FPA	7090	F2	RSBP	126
141	HATRAN, DOSE RATE CALCULATION SNAP GEOMETRY	AI	7090	F2	RS P	128
142	MORTIMER, DOSE RATE CALCULATION SNAP GEOMETRY	AI	7090	F2	RS	130
143	MAC, SHIELD DESIGN MULTIGROUP SLAB GEOMETRY	BNWL	7090	F2	RSBP LT	132
144	DTF, 1-D MULTIGROUP DISCRETE ORDINATE CALC	LNC	1604	F63	RS PLT	135
145	WEAK EXPLCSIGN, COUPLED NEUTRON-HYDRODYNAMICS	APCA	7094	F2	RS P	137
146	NPRECCP, FUEL CYCLE COSTS PERFORMANCE DATA	KE	7090	F2	RSBP	139
147	A1LMDE, X-SECTION CALC ELASTIC SCAT RESONANCES	AI	7090	F+FAF	RS PLT	141
147	A1LMDE, X-SECTION CALC ELASTIC SCAT RESONANCES	AI	360	F4	RS PLT	141
148	TCPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER	PP	7040	F4	RS P T	144
148	TCPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER	PP	7090	F2	RS P T	144
149	TYCFE3, MONTE CARLO SLOWING-DOWN DENSITY CALC	AI	7094	F+FAF	RS PLT	146
150	GANDOFF JR, MODERATOR SPACE CHORD DIST FUNCT	AEG	7090	F2	RS	148
151	DTF2, 1-D MULTI-GP DISCRETE ORDINATE CALC	AI	7090	F2	RS PLT	150
151	ANISN, 1-D MULTI-GP DISCRETE ORDINATE CALC	AI	360	F4	RSBP LT	150
152	ARGLS, TRANSIENT TEMPERATURE CALC CYLINDER	ANL	3600	F63	RSBP T	153
153	PATCHET, COUPLED NEUTRONICS-HYDRODYNAMICS CODE	AGN	7090	F2	RSB	155
154	CRCC90, ML-1 FLUID FLOW EXPERIMENT ANALYSIS	AGN	7090	F2	RS P	157
155	PTH1, BLOWDOWN PRESSURE TEMPERATURE HISTORY	KE	7094	F2	RSBP T	159
156	EXTERMINATOR, 2-D MULTI-GP DIFFUSION PROGRAM	CRNL	7090	F+FAF	RS P T	161
156	EXTERMINATOR2, 2-D MULTI-GP DIFFUSION PROGRAM	CRNL	360	F4	RS P T	161
159	MEMUS, X-SECTION LIBRARY UTILITY PROGRAM	AI	7094	F+FAF	RS LT	165
160	SCPIST1/2/3, MULTI-GP TRANSFER COEFFICIENTS	LRLI	7090	F+FAF	RS P T	167
161	FORTTRAN TCC, 2-D MULTI-GP SN APPROXIMATION RZ	PK	1604	F63	RS P T	169

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162	GRAVE, EXCLP-AVERAGING X-SECTIONS PARAMETERS	AI	7094	F+FAF	RS PLT	172
163	AIRCS, SPACE-INDEPENDENT KINETICS W/FEEEDBACK	AI	7094	F+FAF	RS P T	174
163	AIRCS, SPACE-INDEPENDENT KINETICS W/FEEEDBACK	AI	360	F4	RSBP T	174
164	BLRPF1, DETECTOR EFFICIENCY POINT SOURCE	UM	7090	PAD	RSB	177
165	BLRPF2, DETECTOR EFFICIENCY DISK SOURCE	LP	7090	PAC	RSB	179
166	BLRPF3, DETECTOR EFFICIENCY POINT SOURCE	UM	7090	PAD	RSB	182
167	FLAME, 3-D REACTIVITY AND POWER DISTRIBUTION	GESJ	635	F4	RS P T	185
167	FLARE, 3-D REACTIVITY AND POWER DISTRIBUTION	CDC	3600	F63	RSBP T	185
168	R102, SPACE-INDEPENDENT INVERSE KINETICS CALC	ANL	3600	F63	RSBP	187
168	R102, SPACE-INDEPENDENT INVERSE KINETICS CALC	KAL	7094	F4	RS	187
169	PURPF4, GAMMA-RAY PHOTOFRACTION SOLID CRYSTAL	UM	7090	PAD	RSB	190
170	BLRPF5, GAMMA-RAY PHOTOFRACTION WELL CRYSTAL	LP	7090	PAC	RSB	192
171	NEARREX, COMPOUND NUCLEUS X-SECTION CALC	AKL	3600	F63	RSBP	194
172	AISITE2, PARAMETRIC SITE REQUIREMENT STUDY	AI	7094	F+FAF	RS P T	196
172	R152, PARAMETRIC SITE REQUIREMENT STUDY	ANL	3600	F63	RS P T	196
173	ZCF, 2-D MULTI-GP DISCRETE ORDINATE CODE	LNC-LASL	1604	F63	RS	198
174	FCRE, FAST REACTOR EXCURSION CALCULATIONS	GESJ	2000	F4	RS P T	200
174	FCRE2, FAST REACTOR EXCURSION CALCULATIONS	GESJ	635	F4	RS P T	200
176	RAPTURE, RESONANCE INTEGRAL X-SECTION CALC	GESJ	2000	F2	RS P	203
177	DCPIE, RESOLVED RESONANCE X-SECTION CALC	GESJ	2000	F2	RS P	205
178	SPARTA, SPATIALLY-AVERAGED DOPPLER EFFECTS	GESJ	2000	F2	RS P	207
179	ISOTOPES, MAXIMUM YIELD FROM REACTION OR DECAY	GRNL	1604	F63	RS P	209
180	ISOCRUNCH, REACTION DECAY CHAIN ANALYSIS	ORNL	7090	F2	RS P	211
180	ISOCRUNCH, REACTION DECAY CHAIN ANALYSIS	ORNL	1604	F63	RS P	211
181	XLIBIT, X-SECTION LIBRARY UTILITY ROUTINE	AKL	3600	F63	RSBP T	213
182	AXFLU, HEAT TRANSFER MOLTEN FUEL TUBE BUNDLES	LASL	7094	F2	PS P	215
183	AXTRP, HEAT TRANSFER SOLID FUEL TUBE BUNDLES	LASL	7094	F2	RS P	217
184	THERMOSIANL, THERMAL SPECTRUM X-SECTION CALC	ANL	3600	F63	RS P T	219
185	GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV	BNWL	7090	F+FAF	RS PLT	221
185	GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV	BNWL	1107	F4	RS PLT	221
186	LAG, ASSEMBLER FOR FLECD2 INSTRUCTION SET	PK	1604	F+CCF	RS P T	223
187	PIP, CENTRIFUGAL PUMP IMPELLER DESIGN STUDY	PK	1604	F63	RS P T	225
188	CMXMAT, TRANSFER FUNCTION EVALUATION	PK	1604	F63	RS P	227
189	SKC, CALCULATION OF SK CONSTANTS FOR CSA TDC	PK	1604	F63	RS P	229
190	WCEXPRT, REACTOR WEIGHT OPTIMIZATION STUDY	PK	1604	F63	RS	230
191	AX-TNT, COUPLED NEUTRONICS-HYDRODYNAMICS SPH	PK	1604	F63	RS P	232
192	ZCXYL, 3-D MULTI-GP FLUX SYNTHESIS PROGRAM CYL	PK	1604	F63	RS T	235
193	CSP2A, SN X-SECTION LIBRARY TAPE PREPARATION	PK	1604	F63	RS	237
194	CSP1, SN X-SECTION LIBRARY TAPE PREPARATION	PK	1604	F63	RS	239
195	FNC-A/FNC-G, MC NEUTRON, GAMMA-RAY HISTORIES	PK	1604	F+CCF	RS P T	241
196	CLRIE/DCSE/THUNDERHEAD, EXTERNAL+INTERNAL DCSE	AI	7094	F+FAF	RS PLT	244
197	SPCE, SHIELD WEIGHT OPTIMIZATION CODE CALC	AI	7094	F2	RS P	246
198	FEATING2, TRANSIENT STEADY-STATE HEAT TRANSFER	AI	7094	F2	RS P T	248
199	TLP, 2-D PERTURBATION TDC OR 2DXY FLUX INPUT	PK	1604	F63	RS	250
200	SATURATED BLOWDOWN1, BLOWDOWN ANALYSIS LOFT	KE	7094	F+FAF	RSBP T	252
201	EPITHERMOS, SPECTRUM AND X-SECTION CALCULATION	GEV	7094	F+FAF	RS P T	254
202	MCS, MONTE CARLO NEUTRON PENETRATION STUDY	LASL	7090	FLECC	RS P	256
203	CCMPCC, COMBINED P-W MULTI-LEVEL CONVOLUTION	FP	7040	F4	RS P	258
204	ACN-GAM, FAST SPECTRUM MULTI-GP CONSTANT CALC	AGN	7090	F2	RSBP	260
205	BLOCST5, POINT-KINETICS WITH 2-D HEAT TRANSFER	GA	7044	F4	RS T	262
206	LNPAC, RETRIEVAL FROM SCISRS X-SECTION TAPE	GA	7044	F+FAF	RSBP	264
207	CROSSPLCT, SC4020 PLOTS FROM X-SECTION TAPES	GA	7044	F4	RSBP T	266
208	TRIX1, RESONANCE INTEGRAL X-SECTION CALC	AI	7094	F+FAF	RS PLT	268
209	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	LASL	7030	F4	RS P T	270
209	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	LRC	7094	F4	RS P T	270
209	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	LASL	6600	F4	RS P T	270
209	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	BEC	625	F4	RS P T	270
209	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	ANL	360	F4	RS P T	270
210	DTX, EFFECTIVE X-SECTION CALC FROM DSA OUTPUT	PK	1604	LAG1	RS P	273
211	PCDSN, 1-D MULTI-GP SN APPROX SLAE CYL SPHERE	PK	1604	LAG1	RS P	275
212	VARI-CUIR, TIME-DEP 2-D MULTI-GP DIFFUSION	KAL	7090	F+FAF	RS P T	277
213	RIFF-RAFF, RESONANCE INTEGRAL CALC 2-REG CELL	ANL	3600	F63	RSBP T	279
214	MISH-MASH, RESONANCE INTEGRAL CALC HOMOGENEOUS	ANL	3600	F63	RSBP	281
215	C+AE, LEGENDRE COEF CALC FOR ANGULAR DIST DATA	AI	7094	F+FAF	RS P	283
216	FASOP, X-SECTIONS FROM B-W RESONANCE DATA	GA	7044	F4	RS P	285

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218	GAYER, ENERGY INTERVAL X-SECTION AVERAGING	GA	7044	F4	RS P		289
219	GARCL, RESONANCE OVERLAP AND LATTICE EFFECTS	GA	7044	F+MAP	RS P T		291
220	GASP2, 1-D FEW-GP DIFFUSION POWER DIST SEARCH	GA	7044	F4	RS P T		293
221	RELCOAD-FEYER, 1-D FEW-GP DIFFUSION DEPLETION	GA	7044	F4	RS P T		295
222	GAMBLE4, 2-C MULTI-GP DIFFUSION XY RZ GEOMETRY	GA	7044	F+MAP	RSBP T		297
223	REVISED-GAD, FUEL CYCLE ANALYSIS W/REFUELING	GA	7044	F4	RS P T		299
224	WAMPUM, FUEL CYCLE COSTS PERFORMANCE STUDY	GA	7044	F4	RS P		301
225	TEMCO, 1-D FEW-GP DIFFUSION TEMP COEF CALC	GA	7044	F4	RS P T		303
226	OFUS, POWER PLANT PERFORMANCE AND PRICE STUDY	GA	7044	F+MAP	RS P T		305
227	STNGEN, STEAM GENERATOR DESIGN CRITERIA COSTS	GA	7044	F4	RS P T		307
228	PRECON, HTGR CONTAINMENT PRESSURE POST RUPTURE	GA	7044	F4	RS T		309
229	ELBCW, FUEL ELEMENT STRESS ANALYSIS STUDY	GA	7044	F4	RS P T		311
230	PIZZA, PLANE STRESS ANALYSIS OF 2-D BODIES	GA	7044	F4	RS P T		313
231	HAD2, HTGR FISSION PRODUCT ACTIVITY DIST STUDY	GA	7044	F4	RS P		315
232	GAZELLES, GAS-COOLED CORE THERMAL DESIGN STUDY	GA	7044	F4	RS P		317
233	CCRE, CORE CONFIGURATION FUEL TEMPERATURE CODE	GA	7044	F4	RS		319
234	OPC, DATA PREPARATION FOR 2-D DESIGN PROGRAMS	LASL	7090	F2	RS P T		321
235	GAMPA-P, PRODUCTION X-SECTIONS FOR GAMMA-RAYS	GEC	7094	F4	RS P		323
236	DFSR, DATA FILE SERVICE ROUTINES ENCF TAPES	BNL	7090	F+MAP	RS P T		325
237	BOUNCE, FLUX DIST IN MULTI-PIN FUEL ELEMENT	AGN	7090	F2	RS P		327
238	EXT, X-SECTIONS FROM B-X RESONANCE PARAMETERS	WAL	7094	F2	RS P		329
239	CFS, SC4020 PLOTS FROM SCISRS X-SECTION TAPES	WAL	7094	F2	RS T		331
240	ASSAULT, 2-C MULTI-GP DIFFUSION DEPLETION CODE	ORNL	7090	F+MAP	RS P T		333
241	FPN, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	BNWL	1107	F4	RS P T		336
242	KATM, 2- OR 3-D HEAT CONDUCTION LUMPED MASS	LASL	7094	FAP	RS P T		338
243	ACN-SIGMA, CALC OF MULTI-GP TRANSFER MATRICES	AGN	7090	F2	RS P T		340
244	CYCLOPS1, THERMODYNAMIC CYCLE ANALYSIS	AI	7094	F2	RS PLY		342
246	FLOW-MODEL, MULTI-CHANNEL 2-D 2-PHASE FLOW	AI	7094	F2	RS P		344
247	FLANGE1, SCATTERING LAW X-SECTION CALCULATION	GA	7044	F4	RS		346
248	CCINC, COINCIDENCE COUNTING DATA REDUCTION	ANL	3600	F63	RSBP		348
249	LASER, SPECTRUM CALC WITH BURNUP CYL LATTICE	KAPD	7094	F+MAP	RS PLY		350
250	SAFE-PCRS, STRESS ANALYSIS AXISYMMETRIC LOAD	GA	7044	F4	RS P T		353
251	SAFE-AXISYM, STRESS ANALYSIS AXISYMMETRIC LOAD	GA	7044	F4	RS P T		355
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ARGONNE CODE CENTER: COMPILATION OF PROGRAM ABSTRACTS

by

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Marianne Legan, and L. Ranzini

PREFACE

This is the second complete revision of program abstracts undertaken by the Code Center since its inception in 1960. This revision has eliminated from our collection those programs for machines of the 704 era and earlier. With the assistance of installation representatives and authors, existing program abstracts have been revised and material added to the library to complete, whenever possible, the program package for each program in the Center's collection.

This is the first attempt at a formal publication. Previous abstracts have been processed by use of multilith masters from high-speed printers. Publishing this as an AEC document makes it more easily referenced and accessed. Additions and corrections will be published as previously, with provision for a complete revision in this form after another 3- to 5-year period.

The table of contents lists in order of accession the KWIC title of each program, the originating installation, the machine, the programming language, and the package symbols. The title information was then used to provide the index which follows the abstracts. The package symbols included are defined as follows:

R = reference report or document,
S = source deck or tape,
B = binary or run deck or tape,
P = sample problem data,
L = library information, e.g., cross-section library,
random-number library,

and

T = magnetic tape(s) required for transmittal of card and/or
tape material.

This collection includes programs in which the program number is preceded by the letter R. This denotes restricted, and U.S. citizens are

required to file a release form with the Center for use of the program on domestic applications at a U.S. installation. The Code Center is not authorized to distribute these programs outside the United States; instead, foreign nationals are asked to request this information on a government-to-government basis.

To best service the interests of AEC contractors, university nuclear-engineering departments, and the nuclear industry, the Center will, upon request, supply to an installation, a copy of any of the material listed as available under Item 16 of the abstract. Should that installation modify the program, convert it to a usable form on another computer, uncover an error, or have difficulty in using the program, he is asked to notify the Center so that his efforts in turn might benefit other recipients. The Center maintains records of the recipients of all library material so that if a correction or new version is prepared, all previous recipients of the program are notified promptly.

Program abstracts for the European Nuclear Energy Agency Computer Programme Library programs in the Argonne Code Center collection have not been included in this compilation. They will be issued later as a separate compilation.

I. HISTORY AND ACKNOWLEDGMENTS

Almost twelve years ago, at the Second Annual Meeting of the American Nuclear Society, the initial meeting of an informal group called the Nuclear Codes Group was held. This group was composed of "persons interested in the development and use of computer programs for reactor design." The group held regular meetings in conjunction with the semi-annual ANS meetings and published and distributed a Newsletter containing code abstracts submitted by members. These abstracts followed the format of the Atomic Energy Commission document AECU-3078, "A Bibliography of Available Digital Computer Codes for Nuclear Reactor Problems."¹

From September 1956 to December 1959, ten Newsletters were published and distributed through the auspices of the AEC Computing Facility at New York University.² In 1959, Ward Sangren and personnel at General Atomics edited and published 300 abstracts collected from Group members.³ A supplementary list of 100 abstracts was published the following year.⁴

In 1959 also, the Nuclear Codes Group became the nucleus of the American Nuclear Society's Mathematics and Computation Division. With stature came a desire for a central facility for the computer program library and the dissemination of information concerning programs written in the areas of nuclear physics, reactor design, and engineering. In 1960,

a proposal was made whereby, with the cooperation of Division members and installation representatives, and the Atomic Energy Commission's approval, Argonne National Laboratory undertook to serve as this central agency and the Argonne Code Center was established.

Procedures were drafted defining the material to be collected--the abstract and the "package"--and the responsibilities of the Center, the Installation Representatives, and the Society membership. The submission of the material is the responsibility of the authors--individual members--either directly, or through their Installation Representative. The Center edits and publishes the abstracts, transmitting them to ANS for distribution to the membership, and collects, maintains, tests, and distributes the packages. The representatives at AEC laboratories, contracting establishments, and universities serve as a source of information to the Center concerning programs or requests emanating from their installation, and it is they, in collaboration with the personnel at the Argonne center, who supply the answers to the questions and nonroutine inquiries received. They are responsible for library programs at their installations.

From 1961 to date, the Argonne Code Center published 12 distributions containing abstracts of approximately 265 programs.⁵ This collection represents a complete revision of the Center's published abstracts and includes, in addition, 14 new abstracts published for the first time.

Since the Code Center has been in operation, other specialized program libraries and computer-code collections have been established. These include our cooperating European counterpart, the ENEA Computer Programme Library, established at Ispra, Italy, and the Radiation Shielding Information Center at Oak Ridge National Laboratory (both established in 1964), and the National Aeronautics and Space Administration COSMIC activity, initiated at the University of Georgia in 1966.

II. ABSTRACT FORMAT

The program abstract has been modified considerably over the years. Its evolution from the original AEC-3078 format is due primarily to our experience at the Center and cooperative efforts undertaken with the ENEA library personnel and the ANS-10 subcommittee membership.⁶

A. Name or Designation of Program

This is the name or designation given the program(s) by the author.

B. Computer for Which Program Is Designed and Others upon Which It Is Operable

This is the name of the computer for which the original program was written, and, in addition, names of any other computers for which the program has been converted and entered into the library even though minor modifications may have been made.

C. Nature of Physical Problem Solved

This is a brief description of the physical problem, including any basic physics approximations involved in the problem formulation.

D. Method of Solution

This is a short summary of the mathematical and numerical techniques or algorithms used in the calculation.

E. Restrictions on the Complexity of the Problem

This item includes restrictions implied by storage allocation, such as maximum number of energy groups and mesh points, as well as implied argument-range restrictions due to approximations used, etc.

F. Typical Running Time

This is the detailed information needed to enable the potential user to estimate the running time for a given choice of program parameters.

G. Unusual Features of the Program

This states the distinguishing features of this program and the class of problems that most effectively benefit therefrom. This category should allow the user to select, from a number of similar programs, the one most suitable for a particular problem.

H. Related and Auxiliary Programs

The details should be given here if this program supersedes or is an extension of an earlier program and if other programs are used in connection with this program, either for processing input or output or as subprograms.

I. Status

The Center lists here the initial date of publication of the abstract, as well as the dates on which each version in the library was submitted. Any testing completed at the Center is noted.

J. References

This lists generally available material and documentation pertinent to the program.

K. Machine Requirements

This lists all hardware components necessary for full utilization of the program, including such items as the amount of high-speed memory, any auxiliary or backup storage, such as tapes, disks, and drums, the channel(s) configuration, and other input-output equipment such as on-line punch, printer, clock, display, or recorder.

L. Programming Language(s) Used

This states the programming language or languages in which the program has been written and indicates what percentage is in each. If a certain class of routines is in assembly rather than compiler language, this should be mentioned (in particular, the input-output routines).

M. Operating System or Monitor under Which Program Is Executed

Based on the operating system or monitor and associated subroutine library distributed by the computer manufacturer as "standard," this summarizes deviations pertinent to the operation of the program. It also indicates the installation environment report, if any, associated with the program.

N. Other Programming or Operating Information or Restrictions

This summarizes additional information necessary to permit the reader to decide the extent of changes necessary to convert this program to his use in another operating environment--operating system, programming language, and/or computer.

O. Name and Establishment of Author

This information refers to initial submission. Normally the author will be author of both the program and the abstract. Authors of different computer versions will be indicated here as well.

P. Material Available

This lists the material being distributed, i.e., the program package contents.

Q. Category

This is the problem classification assigned from the Center program classification guide.

Keywords

This is a listing of the keywords associated with the program, supplied by the program author and/or the Center based on the Argonne Code Center thesaurus.

III. RECOMMENDED PROGRAM PACKAGE CONTENTS

This section has been revised to conform to the recommendations outlined in the ANS publication, Nuclear Engineering Bulletin 4-1, September 1966, entitled "A Code of Good Practices for the Documentation of Digital Computer Programs."

A. Card and/or Tape Material

1. Source Deck

These are the compiler and/or assembly language programs as punched on cards or recorded in card image form on magnetic tape.

2. Run Deck

This is the program object deck, including any nonstandard library subroutines utilized, and operating system or monitor control cards set up for execution of the sample problem.

3. Sample Problem

This is the input data deck as set up for execution. Machine listing of storage allocation map and the problem output recorded when executing this sample problem are included if not available in the documentation.

4. Data Library

This includes all data files required for program operation, e.g., cross sections, steam tables.

5. Auxiliary Routines

These are any subsidiary programs useful in preparing input information, processing results, maintaining data libraries, etc.

B. Program Report(s)

1. Program Description

This is the definition of the physical problem as well as the mathematical model. The mathematical and numerical methods employed are described.

2. User's Information

This is the complete set of information required to use the program effectively. It includes operating instructions and a description of the input and output formats and program options in sufficient detail to enable the user to specify his own problem and interpret the results. Input and selected output for a sample problem are included as an example. This example is identical to the sample problem included in the card and/or tape material of the program package.

3. Programmer's Information

Special documentation is provided addressed to program modification and the problem of transferring the program to another machine. Sufficiently detailed information is provided to permit a programmer from another installation to decide whether he can use the program on his computer and then expedite the modifications necessary to make the program operational. This includes:

- a. A description of the hardware configuration employed, including the memory heirarchy and size, and the program utilization of each component.
- b. Operating system information, including loader facilities, restrictions, and limitations, especially in regard to segmented programs.
- c. Flow charts and descriptions of the performance of machine-dependent routines.
- d. Procedures for use and maintenance of auxiliary data libraries required for effective use of the program.
- e. Glossaries giving the correspondence between the symbols used in the text of the report and those used in the program.
- f. An overall view of the logical flow of the program either in schematic flow-chart or descriptive form.

The detailed environment information, items a-d above, can be provided in two ways. One, it may be included in the program report and

should then be consistent with the description of the Installation Environment Report given in Section C below, as pertinent to this program. Or, two, reference may be made to a particular Installation Environment Report with only those optional features and/or deviations pertinent to this program noted in the Program Report.

C. Installation Environment Report

Although a computer program may be completely written in machine-independent language, such as FORTRAN, the program requires a certain minimum environment to operate properly. This environment consists of all the software and hardware devices required to compile and execute the program.

This section of the documentation is designed to specify this required environment. It should be adequate for specification of a replacement environment at another installation. As a minimum, each unit of hardware and software assumed should be listed with a description of how each device is used and how each routine functions. Reference should be made to a complete description, when generally available.

The hardware environment is simply the total collection of devices used either directly or indirectly by this program. This is meant to include mass storage devices, on-line typewriters, clocks, sense switches, and various input and display devices. The amount and hierarchy of memory required for data storage are an important attribute of the hardware environment.

The software environment may be considered in three parts. The first part is the standard set which may be expected to exist at any installation and is generally provided by the manufacturer. This includes standard library subroutines, such as sin and cos; a loader for relocatable loading and linking; a standard compiler for the language use; and an operating or control system. The second part is a set of special configuration-tailored subroutines for data manipulation, storage, and retrieval used in place of statements such as "read" and "write." With the rapid proliferation of mass storage devices, such subroutines can be expected to grow in number and variety. The third part is a catchall category for all other software, such as special matrix manipulative subroutines, free-format input routines, and plotter subroutines, which the originating installation uses as a matter of course in producing many programs.

It is recommended that each installation provide general Installation Environment Reports that can be referenced for details and exceptions in the individual program reports. Although these environment reports are subject to change and must be updated periodically and uniquely identified to serve the reference purposes proposed, their use can greatly simplify the preparation of program packages and facilitate effective program exchange.

IV. PROGRAM CLASSIFICATION GUIDE AND THESAURUS

A program classification scheme is being initiated with this report. It is intended to serve as a guide to those library programs dealing with the solution of a specific physical problem or area of related problems. In addition, a thesaurus has been prepared as a basis for the assignment of keywords to the library programs. The category and keywords listed as Abstract Item 17 have been assigned by the Code Center staff, but it is hoped that in the future they will be selected from the guide and thesaurus by the author of the program and/or abstract. The thesaurus follows the concept and design of the EURATOM thesaurus⁷ insofar as practicable. Accepted keywords not included in the thesaurus include specific reactor and computer code names that are always followed by the word "reactors" or "codes," e.g., HTGR reactors, AITP3 codes. Other accepted keywords are the element names and combinations of an element name and a mass number, e.g., hydrogen, uranium-238.

Program Classification Guide

A. Cross-section and Resonance-integral Calculations

Computation of reaction cross sections from nuclear theory such as the optical or Hauser-Feshbach models, resonance cross sections by Breit-Wigner or multilevel theory, determination of differential scattering cross sections, cross-section evaluation, and compilation programs.

B. Spectrum Calculations, Generation of Group Constants, Lattice and Cell Problems

Determination of the slowing-down density or thermal spectrum, weighting and averaging of cross sections and related quantities for the production of group constants, and evaluation of design parameters by lattice and cell calculation.

C. Static Design Studies

Calculation of the reactivity and flux distribution of the reactor system, and adjustment of design parameters to prescribed specifications, i.e., criticality and power distribution search procedures.

D. Depletion, Fuel Management, Cost Analysis, and Reactor Economics

Includes burnup programs, isotope and fission-product buildup and decay computations, and optimization studies.

E. Space-independent Kinetics

Studies of the time-behavior of reactors, including delayed-neutron effects and feedback mechanisms, and transfer-function evaluation.

F. Space-Time Kinetics, Coupled Neutronics-Hydrodynamics-Thermodynamics and Excursion Simulations

Programs that consider spatial design characteristics and accompanying effects in studying the time behavior of the reactor.

G. Radiological Safety, Hazard and Accident Analysis

Calculation of internal and external dose rates, determination of reactor thermodynamic and hydrodynamic properties following an accident, e.g., release of radioactive materials, coolant system blowdown, steam generator rupture.

H. Steady-state and Transient Heat Transfer

Includes fluid-flow studies and calculations of thermodynamic properties.

I. Deformation and Stress Distribution Computations, Structural Analysis, and Engineering Design Studies

Includes fuel-element design evaluations, core-configuration studies, and composite structure analysis.

J. Gamma Heating and Shield Design Programs

Computation of heat-generation rates, and penetration analysis and leakage calculations for reactor shields.

K. Total Systems Analysis

Collections of solutions to correlated problems elicited from several categories, designed and used as systems.

L. Data Preparation

Generation of program parameters; checking, editing, and formatting of problem input information.

M. Data Management

Construction, maintenance, and retrieval of data files, e.g., cross-section libraries.

N. Subsidiary Calculations

Plotting, editing, and display routines that process output data from other programs.

O. Experimental Data Processing

Programs designed to process data directly acquired from an experimental situation or to assist experimenter in the design of the experiment.

P. General Mathematical and Computing System Routines

Calculation of mathematical functions, and special-language routines with general data-processing capabilities.

Thesaurus

1-dimensional	cylinders
1-group	Dancoff correction
2-dimensional	data processing
2-group	decay
3-dimensional	deformation
absorption	depletion
accidents	design
age	diffusion
alpha decay	disadvantage factors
angular distribution	distance
anisotropic scattering	distribution
annular space	Doppler broadening
assembler	Doppler coefficient
atmosphere	dose rates
averages	economics
B _L method	efficiency
blowdown	elastic scattering
Breit-Wigner formula	elasticity
Brown-St. John model	epithermal
buckling	equations
capture	excursions
cell calculation	expansion
Cohen equation	failures
coincidence methods	fast
compound nucleus	feedback
containment	few-group
continuous release	fission
control	fission products
control rods	fluid flow
coolants	fluids
criticality	flux
cross sections	Fourier transform
crystals	frequency
currents	fuel cycle

fuel elements	preparation
fuels	pressure
gamma radiation	production
gas coolants	programming languages
gases	pumps
geometries	r-theta
graphs	r-z
group constants	radioactivity
Hauser-Feshbach theory	reaction rates
heat transfer	reactivity
heating	reactors
heavy	resolved region
heterogeneous	resonance
hexagonal	resonance escape probability
homogeneous	resonance integrals
hydrodynamics	retrieval
incoherent approximation	scattering
inelastic scattering	scattering law
infinite media	scintillation counters
input data	searches
instantaneous release	Selengut-Goertzel equation
isotopes	shells
isotropic scattering	shielding
kinetics	slabs
lattices	slowing down
leakage	S_n method
least squares	solids
Legendre coefficients	space
libraries	space-independent
lifetime	space-time
light	spectra
liquids	spheres
liquid metals	statistics
maintenance	steam generators
Maxwell distribution	stresses
measurements	structural analysis
moderators	synthesis
Monte Carlo method	temperature
multigroup	temperature coefficient
multilevel	thermal
neutrons	thermal utilization
nonlinear	thermalization
operation	thermodynamics
optical model	transfer functions
output data	transport theory
parameters	unresolved region
performance	vapors
perturbation theory	velocity
pipes	water
P_L method	weight
poison	Wigner-Wilkins model
potential scattering	Wilkins equation
power	x-y
power plants	x-y-z

V. ABSTRACT COLLECTION

As programs are submitted to the Argonne Center, they are assigned accession numbers that are used to identify the program and its abstract. Whenever the abstract is modified, the month and year of the modification appear in the abstract heading in the format MM/YY. Since this collection represents a complete revision, all abstracts appearing herein will be dated October 1967 or later, and the date in the abstract heading will appear as 10/67, etc.

REACTOR CODE ABSTRACT 7

10/67

1. NAME OR DESIGNATION OF PROGRAM - FIRN
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM709
3. NATURE OF PHYSICAL PROBLEM SOLVED - FIRN SOLVES THE TWO-DIMENSIONAL SN APPROXIMATION IN FINITE CYLINDRICAL GEOMETRY. IT IS A FORTRAN ADAPTATION OF THE LOS ALAMOS TDC PROGRAM WRITTEN BY BENGT CARLSON AND CLARENCE LEE. FIRN IS LIMITED TO A MAXIMUM OF SIX GROUPS AND THE S2, S4 OR S6 APPROXIMATION.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MESH STRUCTURE MUST CONTAIN FEWER THAN 60(Z) X 40(R) MESH INTERVALS IN ONE OR FOUR-GROUP PROBLEMS, UNDER 55 X 40 IN SIX-GROUP ONES.
6. TYPICAL RUNNING TIME - ABOUT 1 HOUR IS REQUIRED FOR A ONE-GROUP, 2000 ZONE PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - TDC
9. STATUS - ABSTRACT FIRST DISTRIBUTED 1961.
IBM709 VERSION SUBMITTED FEBRUARY 1963.
10. REFERENCES - BENGT CARLSON, NUMERICAL SOLUTION OF TRANSIENT AND STEADY-STATE NEUTRON TRANSPORT PROBLEMS, LA-2260, MAY 1959.
RICHARD LEVEE, WILLIAM LINDLEY, AND GLORIA SCOGGIN, DESCRIPTION OF FIRN CODE, UCID-4434, FEBRUARY 1962.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
AUTHORS W. LINDLEY AND G. SCOGGIN
PRESENT CONTACT CALVIN D. WOOD
LAWRENCE RADIATION LABORATORY
P. O. BOX 808
LIVERMORE, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (995 CARDS)
REFERENCE REPORTS
17. CATEGORY - C
KEYWORDS - SN METHOD, 2-DIMENSIONAL, R-2, FEW-GROUP, FLUX DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - FIRE2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360
3. NATURE OF PHYSICAL PROBLEM SOLVED - FIRE2 SOLVES THE ONE-DIMENSIONAL MULTIGROUP AGE-DIFFUSION EQUATIONS FOR SLAB (SYMMETRIC AND ASYMMETRIC), CYLINDER, AND SPHERE GEOMETRIES. AN EXTENSION OF THE ORIGINAL LOS ALAMOS FIRE PROGRAM WRITTEN BY F. W. BRINKLEY AND C. B. MILLS, IT CONTAINS A 34-GROUP LIBRARY OF 10 ELEMENTS.
4. METHOD OF SOLUTION - MULTIGROUP EQUATIONS ARE SOLVED BY ITERATING ON THE FISSION SOURCE. FINITE DIFFERENCE EQUATIONS ARE USED IN MULTIREGION PROBLEMS, WHILE A CORE RADIUS MAY BE SPECIFIED FOR EQUIVALENT BARE REACTOR PROBLEMS WITH ONLY THE ENERGY VARIABLE. DETAILED THERMAL FLUX SPECTRA MAY BE COMPUTED USING UPSCATTERING AND DOWNSCATTERING CROSS SECTIONS. IN COMPUTING THE ITH ITERATE OF THE FLUX, THE (I-1)ST ITERATE IS USED TO COMPUTE FISSION SOURCE AND UPSCATTERING, AND THE ITH ITERATE IS USED TO COMPUTE DOWNSCATTERING. FIRE2 COMPUTES FLUX-WEIGHTED AVERAGE VALUES OF THE MACROSCOPIC CROSS SECTIONS WHICH CAN BE USED AS INPUT FOR FEW-GROUP CODES. THE FLUX DISTRIBUTION OBTAINED FROM FIRE2 AND THE CORRESPONDING MULTIGROUP MACROSCOPIC CROSS SECTIONS ARE USED TO OBTAIN THE AVERAGE VALUES. THE FOLLOWING FEW-GROUP CONSTANTS ARE COMPUTED FOR EACH REGION R AND GROUP L - MACROSCOPIC ABSORPTION CROSS SECTION, MODIFIED MACROSCOPIC FISSION CROSS SECTION, DIFFUSION CONSTANT, MACROSCOPIC REMOVAL CROSS SECTION, AND FLUX.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
IF NUMBER OF REGIONS R LESS THAN OR = 12, THEN NUMBER OF GROUPS L LESS THAN OR = 39.
IF R LESS THAN OR = 24, THEN L LESS THAN OR = 19.
MAXIMUM NUMBER OF SPACE POINTS = 180
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED 1961.
IBM704 VERSION SUBMITTED OCTOBER 1961 BY LASL, DELETED OCTOBER 1967.
IBM360 VERSION SUBMITTED DECEMBER 1966.
10. REFERENCES - F. W. BRINKLEY AND C. B. MILLS, A ONE-DIMENSIONAL INTERMEDIATE REACTOR COMPUTING PROGRAM, LA-2161, MARCH 1957.
F. W. BRINKLEY, A ONE-DIMENSIONAL INTERMEDIATE REACTOR COMPUTING PROGRAM, LA-2161 SUPPLEMENT, MAY 1959.
W. MALAN AND R. VAN DER WALT, FIRE-2 A ONE-DIMENSIONAL REACTOR COMPUTING PROGRAM IN FORTRAN IV FOR MULTI-REGION, MULTI-GROUP REACTORS, PEL 131, DECEMBER 1966.

REACTOR CODE ABSTRACT 9

-2-

10/67

11. MACHINE REQUIREMENTS - IBM360 MODEL 40G
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
THE FIRE2 LIBRARY WAS WRITTEN ON DISK BY MEANS OF A SMALL FORTRAN
IV PROGRAM, FIREDATA. MORE ELEMENTS CAN BE ADDED TO THIS LIBRARY
WITH THE SAME FIREDATA PROGRAM.
15. NAME AND ESTABLISHMENT OF AUTHOR -
O. G. P. GROSSKOPF
SOUTH AFRICAN ATOMIC ENERGY BOARD
PRIVATE BAG 256
PELINDABA, PRETORIA, SOUTH AFRICA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (FIRE2 719 CARDS AND FIREBIB 32 CARDS)
SAMPLE PROBLEM (FIRE2 30 CARDS)
LIBRARY (FIRE2 1733 CARDS)
REFERENCE REPORTS
17. CATEGORY - C
KEYWORDS - AGE DIFFUSION, 1-DIMENSIONAL, SLABS, CYLINDERS,
SPHERES, MULTIGROUP, FLUX DISTRIBUTION, FEW-GROUP GROUP
CONSTANTS, FIRE CODES, FIREBIB CODES, FIREDATA CODES

1. NAME OR DESIGNATION OF PROGRAM - HAFEVER
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - HAFEVER CALCULATES THE ENERGY EXCHANGE INELASTIC SCATTERING CROSS SECTION ACCORDING TO THE HAUSER-FESHBACH THEORY MODIFIED TO INCLUDE THE EFFECT OF SPIN-ORBIT COUPLING. THE CROSS SECTION IS INTEGRATED OVER ANGLE.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 MAXIMUM NEUTRON ORBITAL ANGULAR MOMENTUM = 14
 MAXIMUM NUMBER OF ENERGY LEVELS OF TARGET NUCLEUS = 20
 TARGET NUCLEUS IS ORIGINALLY IN GROUND STATE.
6. TYPICAL RUNNING TIME - 5 TO 15 SECONDS ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - THIS PROGRAM IS ONE OF TWO SIMILAR CODES WRITTEN FIRST FOR THE IBM704. THE OTHER, DEVELOPED BY M. GURSKY OF LOS ALAMOS SCIENTIFIC LABORATORY, REQUIRES AT LEAST A 16K MACHINE BUT HAS THE ADVANTAGE OF GIVING THE ANGULAR DISTRIBUTION IF THIS IS CONSIDERED NECESSARY. A CODE WHICH PERFORMS SIMILAR TYPES OF CALCULATIONS HAS ALSO BEEN PREPARED BY M. KALOS AND E. TROUBETZKOY OF NDA FOR THE DATATRON 205. INPUT PENETRABILITIES MAY BE OBTAINED FROM THE SWAMI CODE (KAPL) OR BY ANY OTHER DESIRED METHOD. THE SUBJECT CODE IS ALSO PART OF THE ABACUS SYSTEM DEVELOPED AT KAPL WHICH INCLUDES SWAMI, HAFEVER, AND AN OPTICAL PARAMETER SEARCH.
9. STATUS - ABSTRACT FIRST DISTRIBUTED 1961.
 IBM704 VERSION SUBMITTED JANUARY 1962 BY APDA, DELETED OCTOBER 1967.
 CDC1604 VERSION SUBMITTED AUGUST 1963.
10. REFERENCES - M. H. KALOS AND E. S. TROUBETZKOY, A DESCRIPTION OF THE SORTIE I CODE, NDA PHYS. 1349.
 E. D. REILLY, SWAMI, A NUCLEAR OPTICAL MODEL CODE FOR THE IBM704, KAPL (INTERNAL MEMORANDUM), DECEMBER 7, 1959.
 E. H. AUERBACH, ABACUS 1-PRELIMINARY DESCRIPTION AND INPUT PREPARATION, KAPL-M-EHA-1 PHYSICS AND MATHEMATICS, DECEMBER 15, 1960.
 M. A. FRIEDMAN AND P. F. ZWEIFEL, HAFEVER-AN INELASTIC SCATTERING CODE FOR THE IBM704, APDA-141, SEPTEMBER 1960.
 HAFEVER, NOTES CONCERNING THE CONTROL DATA VERSION.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN 63

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13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
COOP (1604).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
S. ELKIN
NUCLEAR APPLICATIONS COMPUTATION CENTER
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COMPUTER DIVISION
3145 PORTER DRIVE
P. O. BOX 10111
PALO ALTO, CALIFORNIA 94303
16. MATERIAL AVAILABLE -
SOURCE DECK (138 CARDS)
SAMPLE PROBLEM (20 CARDS)
REFERENCE REPORT, APDA-141, AND NOTES
17. CATEGORY - A
KEYWORDS - INELASTIC SCATTERING CROSS SECTIONS, HAUSER-FESHBACH
THEORY

1. NAME OR DESIGNATION OF PROGRAM - 2DXY
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE 2DXY PROGRAM SOLVES THE HOMOGENEOUS OR INHOMOGENEOUS MULTIGROUP EQUATIONS IN X-Y GEOMETRY, USING THE SN TRANSPORT EQUATION APPROXIMATION. VACUUM, SURFACE SOURCE, OR REFLECTING BOUNDARY CONDITIONS ARE AVAILABLE AS OPTIONS. IN THE HOMOGENEOUS CASE THE USER MAY REQUEST THE COMPUTATION OF REACTIVITY, REACTOR PERIOD, CRITICAL CONCENTRATIONS OF SOME COMPOSITION, OR THE CRITICAL THICKNESS OF A ZONE.
4. METHOD OF SOLUTION - 2DXY USES THE SN EQUATIONS IN A FORM APPROPRIATE TO X-Y GEOMETRY. IN THIS SENSE IT IS AN EXTENSION OF TOC.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - SCATTERING MUST BE ISOTROPIC.
6. TYPICAL RUNNING TIME - ONE AND ONE-HALF HOURS ARE REQUIRED FOR A 6-GROUP, 1000 MESH POINT PROBLEM ON THE 7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED 1961.
IBM704 VERSION SUBMITTED JANUARY 1962, DELETED OCTOBER 1967.
IBM7090 VERSION SUBMITTED JANUARY 1962.
10. REFERENCES - J. BENGSTON, S. T. PERKINS, T. W. SHEHEEN, AND D. W. THOMPSON, 2DXY - A TWO-DIMENSIONAL CARTESIAN COORDINATE SN TRANSPORT CALCULATION, AGN-TM-392, JUNE 1961.
B. CARLSON, C. LEE, AND J. WORTON, THE DSN AND TOC NEUTRON TRANSPORT CODES, LAMS-2346, FEBRUARY 1960.
11. MACHINE REQUIREMENTS - 32K MEMORY AND 5 TAPE UNITS
12. PROGRAMMING LANGUAGE USED - FLOCO 11-D
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - BINARY EDITOR (SUPPLIED WITH THE CODE).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
S. T. PERKINS AND D. W. THOMPSON
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LIVERMORE, CALIFORNIA 94551

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10/67

15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)

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21000 BROOKPARK ROAD
CLEVELAND, OHIO 44135

16. MATERIAL AVAILABLE - (780 CARDS)

SOURCE DECK
FLOCO II BINARY DECK
SAMPLE PROBLEM
BINARY EDITOR DECK
REFERENCE REPORT, AGN-TM-392

17. CATEGORY - C

KEYWORDS - SN METHOD, 2-DIMENSIONAL, X-Y, MULTIGROUP, CRITICALITY
SEARCHES, FLUX DISTRIBUTION, ISOTROPIC SCATTERING

1. NAME OR DESIGNATION OF PROGRAM - FOG
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE FOG PROGRAM SOLVES THE ONE-DIMENSIONAL FEW-GROUP DIFFUSION EQUATIONS IN ANY OF THREE GEOMETRIES SLAB, CYLINDER, OR SPHERE. PROVISIONS ARE MADE FOR CALCULATING THE FLUX, THE ADJOINT FLUX, AND VARIOUS CRITICALITY SEARCHES AS WELL AS A BUCKLING ITERATION AND AUTOMATIC TSCHEBYSCHIEFF POLYNOMIAL COMPUTATION OF SOURCE EXTRAPOLATION FACTORS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
INPUT DATA MUST BE MACROSCOPIC.
SCATTERING IS LIMITED TO THE NEXT LOWER GROUP.
1-4 ENERGY GROUPS
MAXIMUM NUMBER OF MESH POINTS = 239
MAXIMUM NUMBER OF REGIONS = 40
6. TYPICAL RUNNING TIME - A TYPICAL PROBLEM USUALLY REQUIRES LESS THAN A MINUTE.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - AIM6 (ACC ABSTRACT 29)
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1962.
IBM7090 VERSION SUBMITTED JANUARY 1962.
CDC1604 VERSION SUBMITTED MARCH 1964.
10. REFERENCE - H. P. FLATT, THE FOG ONE-DIMENSIONAL DIFFUSION EQUATION CODES, NAA-SR-6104, 1961.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM) AND FORTRAN 63 (CDC)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
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P. O. BOX 309
CANOGA PARK, CALIFORNIA

15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)

1604

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7090-2840 CARDS AND 1604-2849 CARDS)
SAMPLE PROBLEMS (7090-37 CARDS AND 1604-63 CARDS)
REFERENCE REPORT

17. CATEGORY - C

KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, FEN-GROUP, SLABS,
CYLINDERS, SPHERES, CRITICALITY SEARCHES, FLUX DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - AIM6
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - AIM6 SOLVES THE ONE-DIMENSIONAL MULTIGROUP DIFFUSION EQUATIONS UTILIZING A MICROSCOPIC CROSS SECTION LIBRARY. ANY OF THREE GEOMETRIES ARE AVAILABLE SLAB, CYLINDER OR SPHERE. CRITICALITY SEARCHES ARE PROVIDED INCLUDING A CONCENTRATION SEARCH ON ONE OR TWO ELEMENTS. HOMOGENEOUS AND INHOMOGENEOUS PROBLEMS MAY BE SOLVED WITH A VARIETY OF BOUNDARY CONDITION OPTIONS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF SPACE POINTS = 10
MAXIMUM NUMBER OF ENERGY GROUPS = 18
ONLY DOWNSCATTER IS PERMITTED, AND, IN THE CURRENT VERSION, NEUTRONS FROM A GIVEN GROUP ARE PERMITTED TO SCATTER ONLY TO A MAXIMUM OF 5 SUCCESSIVE LOWER GROUPS.
6. TYPICAL RUNNING TIME - FOR 16 GROUPS, 3 MINUTES WOULD BE A TYPICAL TIME FOR A SINGLE PROBLEM, ALTHOUGH TIMES MAY BE AS LOW AS 30 SECONDS.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - FOG (ACC ABSTRACT 28)
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1962.
IBM7090 VERSION SUBMITTED JANUARY 1962.
CDC1604 VERSION SUBMITTED AUGUST 1963.
10. REFERENCES - H. P. FLATT AND D. C. BALLER, THE AIM-6 CODE, NAA PROGRAM DESCRIPTION, JANUARY 1961, ERRATA AND ADDENDA.
D. P. SATKUS, LIBRARY, A PROGRAM TO PUNCH MICROSCOPIC CROSS SECTION LIBRARY IN COLUMN BINARY FORM FOR A VARIABLE NUMBER OF GROUPS, NAA PROGRAM DESCRIPTION, APRIL 19, 1960.
D. P. SATKUS, LIST, A PROGRAM TO LIST LIBRARY FOR A VARIABLE NUMBER OF GROUPS, NAA PROGRAM DESCRIPTION, APRIL 19, 1960.
AIM-6, NOTES CONCERNING THE CONTROL DATA VERSION.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP (IBM), FORTRAN 63 (CDC)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7090 FORTRAN MONITOR SYSTEM.

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14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7090-3852 CARDS AND 1604-3288 CARDS)
SAMPLE PROBLEMS (7090-37 CARDS, 1604-30 CARDS)
LIBRARIES (7090-1222 CARDS AND 1604-3318 CARDS)
REFERENCE REPORTS, ERRATA, ADDENDA, AND NOTES

17. CATEGORY - C

KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, MULTIGROUP, SLABS,
CYLINDERS, SPHERES, CRITICALITY SEARCHES, FLUX DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - PERT
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, 360, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - PERT IS A PERTURBATION PROGRAM DESIGNED FOR USE WITH THE AIM6 AND FOG PROGRAMS. PUNCHED CARD OUTPUT FROM THESE CODES IS USED AS INPUT TO PERT. USING CROSS SECTION DATA, FLUXES, AND ADJOINT FLUXES, THE RELATIVE CHANGE IN KEFF CAN BE CALCULATED. CROSS SECTIONS MAY BE WEIGHTED WITH THE ADJOINT FLUX AND/OR DIRECT FLUX. THE NEUTRON LIFETIME FOR THE DELAY GROUPS MAY ALSO BE DETERMINED.
4. METHOD OF SOLUTION - A LINEAR PERTURBATION THEORY IS USED FOR THE CALCULATIONS OF THE RELATIVE CHANGE IN KEFF.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - ABOUT 30 SECONDS ARE REQUIRED FOR A TYPICAL PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - AIM6 (ACC ABSTRACT 29) AND FOG (ACC ABSTRACT 28)
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1962.
IBM7090 VERSION SUBMITTED JANUARY 1962.
CDC1604 VERSION SUBMITTED MARCH 1964.
IBM360 VERSION SUBMITTED JUNE 1967.
10. REFERENCES - H. P. FLATT, PERT, NAA PROGRAM DESCRIPTION, FEBRUARY 1961.
PERT, NOTES CONCERNING THE CONTROL DATA VERSION.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (7090), FORTRAN 63 (1604), AND FORTRAN IV (360)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
7090 R. A. BLAINE
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REACTOR CODE ABSTRACT 30

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10/67

15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)

360

G. GOWINS
BOEING HUNTSVILLE SIMULATION CENTER
THE BOEING COMPANY
HUNTSVILLE, ALABAMA 35807

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NUCLEAR APPLICATIONS COMPUTATION CENTER
CONTROL DATA CORPORATION
COMPUTER DIVISION
3145 PORTER DRIVE
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PALO ALTO, CALIFORNIA 94303

16. MATERIAL AVAILABLE -

SOURCE DECKS (7090-443 CARDS, 1604-446 CARDS, 360-457 CARDS)
SAMPLE PROBLEM (360-114 CARDS)
REFERENCE REPORT AND NOTES

17. CATEGORY - C

KEYWORDS - PERTURBATION THEORY, 1-DIMENSIONAL, REACTIVITY, LIFE-
TIME, SLABS, CYLINDERS, SPHERES

1. NAME OR DESIGNATION OF PROGRAM - WHIRLAWAY
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - WHIRLAWAY SOLVES THE TWO-GROUP, THREE-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN X-Y-Z GEOMETRY.
4. METHOD OF SOLUTION - THIS CODE USES THE SAME ITERATIVE PROCEDURE (THE EQUIPOISE METHOD) THAT IS USED IN THE TWO-DIMENSIONAL CODE EQUIPOISE3 (ACC ABSTRACT 39).
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF GROUPS = 2
MAXIMUM NUMBER OF MESH POINTS = 12,750
MAXIMUM NUMBER OF COMPOSITIONS = 100
MAXIMUM NUMBER OF REGIONS = 100
6. TYPICAL RUNNING TIME - APPROXIMATELY 0.006 SECOND PER POINT-ITERATION IS REQUIRED, FROM 1 1/2 TO 4 HOURS FOR A 10,000 POINT PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM - THIS CODE WILL COMPUTE ADJOINT FLUXES AND DIRECT-ADJOINT FLUX REGIONAL INTEGRALS AUTOMATICALLY IF DESIRED.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1962.
IBM7090 VERSION SUBMITTED FEBRUARY 1962.
CDC1604 VERSION SUBMITTED AUGUST 1963.
10. REFERENCES - T. B. FOWLER AND MELVIN TOBIAS, WHIRLAWAY--A THREE-DIMENSIONAL NEUTRON DIFFUSION CODE FOR THE IBM-7090 COMPUTER, ORNL-3150, AUGUST 15, 1961, ERRATA AND ADDENDUM, JANUARY 2, 1962.
WHIRLAWAY, NOTES CONCERNING THE CONTROL DATA VERSION.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (7090), FORTRAN 63 (1604)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM FORTRAN II MONITOR (7090) AND COOP (1604).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
7090 T. B. FOWLER AND MELVIN TOBIAS
OAK RIDGE NATIONAL LABORATORY
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REACTOR CODE ABSTRACT 32

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10/67

15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECKS (7090-2771 CARDS AND 1604-2809 CARDS)

SAMPLE PROBLEMS (7090-11 CARDS AND 1604-11 CARDS)

REFERENCE REPORT, ERRATA, ADDENDUM, AND NOTES

17. CATEGORY - C

KEYWORDS - DIFFUSION EQUATIONS, 3-DIMENSIONAL, 2-GROUP, X-Y-Z,
FLUX DISTRIBUTION, REACTIVITY

1. NAME OR DESIGNATION OF PROGRAM - GAM1/REP/UPDATE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM COMPUTES THE SLOWING-DOWN SPECTRUM IN EITHER THE P1 OR THE B1 APPROXIMATION USING 68 GROUPS OF NEUTRONS WITH A CONSTANT GROUP WIDTH $\Delta U=0.25$, MULTIGROUP CONSTANTS ARE CALCULATED FOR UP TO 32 FAST GROUPS.
4. METHOD OF SOLUTION - SPECIAL FEATURES OF THIS CODE INCLUDE -
 - (A) A SUBROUTINE THAT CALCULATES RESONANCE INTEGRALS FROM THE RESONANCE PARAMETERS FOR EACH GROUP USING THE QUANTITATIVE METHODS DEVELOPED BY L. W. NORDHEIM.
 - (B) THE ENERGY ANGLE CORRELATION IS RETAINED FOR SLOWING-DOWN IN ALL ISOTOPES. THAT IS, THE P0 AND P1 COMPONENTS OF THE SCATTERING KERNEL ARE TREATED RIGOROUSLY. FOR THE COMMON MODERATING MATERIALS AND FOR SOME OF THE MORE COMMON ISOTOPES, TERMS UP TO P6 IN THE LEGENDRE EXPANSION OF THE SCATTERING CROSS SECTION IN THE CENTER OF MASS SYSTEM ARE RETAINED. FOR OTHER ISOTOPES, THE SCATTERING MATRICES ARE CORRECT FOR LINEARLY ANISOTROPIC SCATTERING IN THE CENTER OF MASS SYSTEM.
 - (C) THE CODE CONTAINS AN OPTION THAT WILL CALCULATE THE NEUTRON AGE IN AN INFINITE MEDIUM BY THE MOMENTS METHOD.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - NINE DIFFERENT SOURCE SPECTRA ARE INCLUDED AS OPTIONS.
6. TYPICAL RUNNING TIME - 1 TO 5 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM - THE CODE CONTAINS A LARGE LIBRARY. AT PRESENT, THE LIBRARY TAPE CONSISTS OF 127 NUCLIDES. THE LIBRARY TAPE CONTAINS ALL OF THE DATA NEEDED IN THE CALCULATION FOR EACH OF THE 68 SUBGROUPS. INELASTIC SCATTERING AND (N,2N) PROCESSES ARE EXPLICITLY INCLUDED. SELF-SHIELDING FACTORS MAY BE INCLUDED FOR ANY NUCLIDE, IF DESIRED.
8. RELATED AND AUXILIARY PROGRAMS - REP, TO REPRODUCE GAM LIBRARY TAPE, AND UPDATE, TO UPDATE GAM LIBRARY TAPE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1962.
IBM7090 VERSION SUBMITTED FEBRUARY 1962.
CDC1604 VERSION SUBMITTED AUGUST 1963.
10. REFERENCES - G. D. JOANDU, E. J. LESHAN, AND J. S. DUDEK, GAM-1, A CONSISTENT P1 MULTIGROUP CODE FOR THE CALCULATION OF THE FAST NEUTRON SPECTRUM AND MULTIGROUP CONSTANTS, GA-1850, MAY 1961.
G. D. JOANDU, J. S. DUDEK, A. J. GOODJOHN, N. F. WIKNER, AND J. D. GARRISON, NUCLEAR DATA FOR GAM-1 DATA TAPE, GA-2451, VOLUMES I AND II, AUGUST 1961.

10. REFERENCES (CONTINUED)

F. T. ADLER, G. W. HINMAN, AND L. W. NORDHEIM, THE QUANTITATIVE EVALUATION OF RESONANCE INTEGRALS, PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON PEACEFUL USES OF ATOMIC ENERGY, VOL. 16, PP. 155-170, GENEVA, 1958.

FORMAT OF GAM-1 BCD LIBRARY INFORMATION, ARGONNE CODE CENTER NOTE, AUGUST 10, 1966.

GAM-1, NOTES CONCERNING THE CONTROL DATA VERSION.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM7090), FORTRAN 60, AND FORTRAN 63 (CDC1604)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN MONITOR SYSTEM (IBM7090) AND COOP MONITOR (CDC1604).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECKS (7090-819 CARDS, 1604-1478 CARDS)
SAMPLE PROBLEMS (7090-21 CARDS, 1604-18 CARDS)
LIBRARIES (BCD-7090 AND 1604-16607 CARDS EACH)
REP SOURCE DECKS (7090-223 CARDS, 1604-46 CARDS)
UPDATE SOURCE DECK (7090-588 CARDS)
REFERENCE REPORT, GA-1850, AND NOTES
MEMORANDA - THE STRUCTURE OF THE GAM DATA TAPE,
GAM CODE,
GAM LIBRARY TAPE,
NEW GAM INPUT.

17. CATEGORY - B

KEYWORDS - SLOWING DOWN SPECTRA, FAST NEUTRONS, MULTIGROUP GROUP CONSTANTS, RESONANCE INTEGRALS, ANISOTROPIC SCATTERING, AGE, PL METHOD, BL METHOD, REP CODES, UPDATE CODES

1. NAME OR DESIGNATION OF PROGRAM - EQUIPOISE3
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - EQUIPOISE3 SOLVES THE TWO-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL OR SLAB GEOMETRY.
4. METHOD OF SOLUTION - THE EQUIPOISE METHOD DESCRIBED IN REFERENCE 2 BELOW IS USED TO SOLVE THE FINITE-DIFFERENCE ANALOGS OF THE TWO-GROUP NEUTRON DIFFUSION EQUATIONS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF GROUPS * 2
 - MAXIMUM NUMBER OF MESH POINTS * 2100
 - MAXIMUM NUMBER OF COMPOSITIONS * 50
 - MAXIMUM NUMBER OF REGIONS * 100
6. TYPICAL RUNNING TIME - APPROXIMATELY 0.0017 SECOND PER POINT PER ITERATION IS REQUIRED, ABOUT 5 MINUTES FOR A 1000-POINT PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM - THIS CODE IS INTENDED TO FILL THE NEED FOR A RAPID TWO-DIMENSIONAL CALCULATION SUITABLE FOR SURVEY CALCULATIONS. MAGNETIC TAPES ARE USED ONLY FOR INPUT, OUTPUT, AND PROGRAM STORAGE. THE LOGARITHMIC DERIVATIVE BOUNDARY CONDITION IS ALLOWED, AND ADJOINT FLUXES AND ASSOCIATED DIRECT-ADJOINT FLUX REGION INTEGRALS MAY BE CALCULATED AUTOMATICALLY IF DESIRED.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED FEBRUARY 1962.
10. REFERENCES - T. B. FOWLER AND M. L. TOBIAS, EQUIPOISE-3, A TWO-DIMENSIONAL, TWO-GROUP NEUTRON DIFFUSION CODE FOR THE IBM-7090 COMPUTER, ORNL-3199, FEBRUARY 1962.
M. L. TOBIAS AND T. B. FOWLER, THE EQUIPOISE METHOD - A SIMPLE PROCEDURE FOR GROUP-DIFFUSION CALCULATIONS IN TWO AND THREE DIMENSIONS, NUCLEAR SCIENCE AND ENGINEERING, VOL. 12, PP. 513-518, 1962.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II (7090)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM FORTRAN II MONITOR (7090).

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14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
7090 T. B. FOWLER AND M. L. TOBIAS
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OAK RIDGE, TENNESSEE 37831
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (7090-2481 CARDS)
SAMPLE PROBLEM (7090-15 CARDS)
REFERENCE REPORT, ORNL-3199
17. CATEGORY - C
KEYWORDS - DIFFUSION EQUATIONS, 2-DIMENSIONAL, 2-GROUP, SLABS,
CYLINDERS, FLUX DISTRIBUTION, REACTIVITY

1. NAME OR DESIGNATION OF PROGRAM - ZOGRAND
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604,3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - ZOGRAND SOLVES THE FEW-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL OR SLAB GEOMETRY.
4. METHOD OF SOLUTION - THE METHOD USED IS THE SAME AS THAT USED IN EQUIPOISE3 (ACC ABSTRACT 39).
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF GROUPS = 6
 - MAXIMUM NUMBER OF MESH POINTS = 3000
 - MAXIMUM NUMBER OF COMPOSITIONS = 50
 - MAXIMUM NUMBER OF REGIONS = 100
6. TYPICAL RUNNING TIME - APPROXIMATELY 0.0035 SECOND PER POINT PER ITERATION PER GROUP IS REQUIRED, ABOUT 30 MINUTES FOR A 1000-POINT, FOUR-GROUP PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM - NEUTRON TRANSFER FROM ANY GROUP TO ANY OTHER GROUP IS PERMITTED. THE LOGARITHMIC DERIVATIVE BOUNDARY CONDITION IS ALLOWED, AND THE ADJOINT FLUX OPTION IS AVAILABLE.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
 - IBM7090 VERSION SUBMITTED FEBRUARY 1962.
 - CDC1604 VERSION SUBMITTED AUGUST 1963.
10. REFERENCES - MELVIN L. TOBIAS AND T. B. FOWLER, THE TWENTY GRAND PROGRAM FOR THE NUMERICAL SOLUTION OF FEW-GROUP NEUTRON DIFFUSION EQUATIONS IN TWO DIMENSIONS, ORNL-3200, FEBRUARY 1962.
 - TWENTY GRAND, NOTES CONCERNING THE CONTROL DATA VERSION.
 - S. ELKIN, CONVERSION OF TWENTY GRAND 1604 VERSION TO 3600 VERSION, DECEMBER 2, 1963.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (7090), FORTRAN 60 OR FORTRAN 63 (1604,3600)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM FORTRAN II MONITOR (7090) AND COOP (1604).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

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15. NAME AND ESTABLISHMENT OF AUTHORS -

7090

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECKS (7090-2486 CARDS AND 1604-2526 CARDS)

SAMPLE PROBLEMS (7090-23 CARDS AND 1604-23 CARDS)

REFERENCE REPORT AND NOTES

17. CATEGORY - C

KEYWORDS - DIFFUSION EQUATIONS, 2-DIMENSIONAL, FEW-GROUP, SLABS,
CYLINDERS, FLUX DISTRIBUTION, REACTIVITY

1. NAME OR DESIGNATION OF PROGRAM - ZUT
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - ZUT COMPUTES RESONANCE INTEGRALS FROM RESONANCE PARAMETERS FOR A WIDE VARIETY OF TEMPERATURES, COMPOSITIONS, AND GEOMETRIES FOR THE RESOLVED RESONANCES.
4. METHOD OF SOLUTION - THE FORM USED PERMITS SPECIFICATION OF ESCAPE PROBABILITY AS A FUNCTION OF THE LUMP DIMENSION AND THE MEAN FREE PATH. THE ABSORBER TERM MAY BE TREATED BY THE INTEGRAL METHOD, THE NARROW RESONANCE OR THE INFINITE MASS APPROXIMATION. MODERATOR TERMS MAY BE REPRESENTED EITHER BY THE FULL INTEGRAL METHOD (IM) OR THE ASYMPTOTIC (NR) FORM.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 11 SECONDS ARE REQUIRED FOR EACH CROSS SECTION CALCULATION (CALCULATED ONCE FOR EACH UNIQUE RESONANCE PARAMETER AND TEMPERATURE SET).
7. UNUSUAL FEATURES OF THE PROGRAM-
8. RELATED AND AUXILIARY PROGRAMS - TUZ (ACC ABSTRACT 42)
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
10. REFERENCES - G. F. KUNCIR, A PROGRAM FOR THE CALCULATION OF RESONANCE INTEGRALS, GA-2525, AUGUST 28, 1961.
L. W. NORDHEIM, A PROGRAM OF RESEARCH AND CALCULATIONS OF RESONANCE ABSORPTION, GA-2527, AUGUST 28, 1961, AND ADDENDUM.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1566 CARDS)
BINARY DECK (379 CARDS)
REFERENCE REPORTS AND ADDENDUM
17. CATEGORY - A
KEYWORDS - RESOLVED REGION RESONANCE INTEGRALS, TEMPERATURE

1. NAME OR DESIGNATION OF PROGRAM - TUZ
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - TUZ COMPUTES RESONANCE INTEGRALS FOR A WIDE VARIETY OF TEMPERATURES, COMPOSITIONS, AND GEOMETRIES FOR THE UNRESOLVED RESONANCES.
4. METHOD OF SOLUTION - THE RESONANCES ARE CONSIDERED TO BE DEFINED BY AN AVERAGE OVER THE PORTER-THOMAS DISTRIBUTION OF NEUTRON WIDTHS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 11 SECONDS ARE REQUIRED FOR EACH CROSS SECTION CALCULATION (CALCULATED ONCE FOR EACH UNIQUE RESONANCE PARAMETER AND TEMPERATURE SET).
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - ZUT (ACC ABSTRACT 41)
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
10. REFERENCES - G. F. KUNCIR, A PROGRAM FOR THE CALCULATION OF RESONANCE INTEGRALS, GA-2525, AUGUST 28, 1961.
L. W. NORDHEIM, A PROGRAM OF RESEARCH AND CALCULATIONS OF RESONANCE ABSORPTION, GA-2527, AUGUST 28, 1961, AND ADDENDUM.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1332 CARDS)
BINARY DECK (114 CARDS)
REFERENCE REPORTS AND ADDENDUM

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17. CATEGORY - A

KEYWORDS - UNRESOLVED REGION RESONANCE INTEGRALS, TEMPERATURE

1. NAME OR DESIGNATION OF PROGRAM - GRACE1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - GRACE1 IS A MULTIGROUP, MULTI-REGION, GAMMA-RAY ATTENUATION PROGRAM DESIGNED PRIMARILY FOR COMPUTING GAMMA-RAY HEATING AND GAMMA-RAY DOSE RATES IN MULTIREGION FINITE OR SEMI-INFINITE SLAB SHIELDS. A DIFFERENT BUILDUP FACTOR MAY BE SPECIFIED FOR EACH SOURCE REGION CONSIDERED.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF REGIONS = 30
 - MAXIMUM NUMBER OF MESH POINTS IN EACH REGION = 10
 - MAXIMUM NUMBER OF GAMMA-RAY ENERGY GROUPS = 20
 - MAXIMUM NUMBER OF SHIELD MATERIALS = 10
 - MAXIMUM NUMBER OF MATERIAL BUILDUP FACTORS = 5
6. TYPICAL RUNNING TIME - A SAMPLE PROBLEM INVOLVING 1 SOURCE REGION, 9 MESH POINTS AND 1 ENERGY GROUP REQUIRED 39 SECONDS ON THE 7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - GRACE2 (ACC ABSTRACT 46)
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
 - IBM7090 VERSION SUBMITTED MARCH 1962.
 - CDC1604 VERSION SUBMITTED MARCH 1964.
10. REFERENCES - D. S. DUNCAN AND A. B. SPEIR, GRACE I, AN IBM 704-709 PROGRAM DESIGNED FOR COMPUTING GAMMA-RAY ATTENUATION AND HEATING IN REACTOR SHIELDS, NAA-SR-3719, 1959.
 - J. AGRESTA, GRACE-I NOTE, UNION CARBIDE CORPORATION.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM7090) AND FORTRAN 63 (CDC1604)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
 - 7090 R. A. BLAINE
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15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)

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16. MATERIAL AVAILABLE -

SOURCE DECKS (7090-677 CARDS AND 1604-679 CARDS)

SAMPLE PROBLEMS (7090-26 CARDS AND 1604-39 CARDS)

REFERENCE REPORT AND NOTE

17. CATEGORY - J

KEYWORDS - GAMMA RADIATION, HEATING, DOSE RATES, SLABS, SHIELDING,
MULTIGROUP

1. NAME OR DESIGNATION OF PROGRAM - GRACE2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - GRACE2 IS A MULTIGROUP, MULTIREGION, GAMMA-RAY ATTENUATION PROGRAM TO COMPUTE THE TOTAL DOSE RATE OR HEAT GENERATION RATE FROM EITHER A SPHERICAL OR A CYLINDRICAL SOURCE. THE SOURCE, WHICH MAY BE LOCATED IN EITHER THE CENTRAL REGION OF THE SYSTEM OR IN A CONCENTRIC SHELL REGION SURROUNDING IT, MAY BE UNIFORM, EXPONENTIAL, OR HAVE A POLYNOMIAL VARIATION IN THE RADIAL DIRECTION. IN THE CASE OF CYLINDRICAL GEOMETRY, IT MAY ALSO HAVE A POLYNOMIAL VARIATION IN THE AXIAL DIRECTION.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF REGIONS = 22
 - MAXIMUM NUMBER OF MESH POINTS IN EACH REGION = 10
 - MAXIMUM NUMBER OF GAMMA-RAY ENERGY GROUPS = 20
 - MAXIMUM NUMBER OF SHIELD MATERIALS = 20
 - MAXIMUM NUMBER OF MATERIAL BUILDUP FACTORS = 20
6. TYPICAL RUNNING TIME - A SAMPLE PROBLEM REQUIRED 3.64 MINUTES ON THE 7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - GRACE1 (ACC ABSTRACT 45)
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
 - IBM7090 VERSION SUBMITTED MARCH 1962.
 - CDC1604 VERSION SUBMITTED MARCH 1964.
10. REFERENCE - D. S. DUNCAN AND A. B. SPEIR, GRACE II, AN IBM 709 PROGRAM FOR COMPUTING GAMMA-RAY ATTENUATION AND HEATING IN CYLINDRICAL AND SPHERICAL GEOMETRIES, NAA-SR-MEMO-4649, 1959.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM7090) AND FORTRAN 63 (CDC1604)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

REACTOR CODE ABSTRACT 46

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10/67

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE -

SOURCE DECKS (7090-899 CARDS AND 1604-892 CARDS)
SAMPLE PROBLEMS (7090-18 CARDS AND 1604-18 CARDS)
REFERENCE REPORT

17. CATEGORY - J

KEYWORDS - GAMMA RADIATION, HEATING, DOSE RATES, CYLINDERS, SLABS,
SHIELDING, MULTIGROUP

1. NAME OR DESIGNATION OF PROGRAM - CLOUD
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604, IBM360
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE CLOUD PROGRAM CALCULATES THE EXTERNAL GAMMA-RAY DOSE RATE AND TOTAL INTEGRATED DOSE RESULTING FROM THE CONTINUOUS RELEASE OF RADIOACTIVE MATERIALS TO THE ATMOSPHERE.
4. METHOD OF SOLUTION - METEOROLOGICAL PARAMETERS SUCH AS WIND VELOCITY, LATERAL AND VERTICAL DIFFUSION PARAMETERS, STABILITY PARAMETERS AND THE PRESENCE OF PHYSICAL BOUNDARIES SUCH AS A GROUND SURFACE AND A TEMPERATURE INVERSION LAYER, ARE CONSIDERED. DECAY OF THE SOURCE MATERIAL IS DESCRIBED EITHER BY THE USE OF A SIMPLE PARENT-DAUGHTER DECAY SCHEME OR BY A WAY-WIGNER TYPE RELATIONSHIP.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 2 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
CDC1604 VERSION SUBMITTED MARCH 1964.
IBM360 VERSION SUBMITTED MARCH 1967.
10. REFERENCES - D. S. DUNCAN, CLOUD, AN IBM 709 PROGRAM FOR COMPUTING GAMMA-RAY DOSE RATE FROM A RADIOACTIVE CLOUD, NAA-SR-MEMO-4822, 1959.
CLOUD, NOTES CONCERNING THE CONTROL DATA VERSION.
R. E. COOPER, SAVANNAH RIVER LABORATORY CHANGES TO A1 CLOUD PROGRAM - IBM 360 VERSION.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM7090), FORTRAN 60 (CDC1604), AND FORTRAN IV (IBM360)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

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10/67

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE -

SOURCE DECKS (7090-800 CARDS, 1604-793 CARDS, AND
360-822 CARDS)
SAMPLE PROBLEMS (7090-53 CARDS, 1604-52 CARDS, AND
360-23 CARDS)
REFERENCE REPORTS AND NOTES

17. CATEGORY - G

KEYWORDS - DOSE RATES, GAMMA RADIATION, CONTINUOUS RELEASE, RADIO-
ACTIVITY, ATMOSPHERE, DECAY

1. NAME OR DESIGNATION OF PROGRAM - FUGUE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE FUGUE PROGRAM COMPUTES STEADY-STATE WALL AND BULK FLUID TEMPERATURE, VOID FRACTION, AND LOCAL PRESSURE IN LIQUID-COOLED CLOSED CHANNELS IN WHICH THE HEATING RATE IS SPECIFIED. THE REQUIRED RELATIONSHIPS ARE EXPRESSED IN GENERAL, NON-DIMENSIONAL FORM AND COMBINED IN AN INTERNALLY CONSISTENT MANNER TO ALLOW PREDICTIONS FOR A VARIETY OF COOLANTS AND SPECIFIED OPERATING CONDITIONS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - A MAXIMAL PROBLEM REQUIRES ABOUT 1 MINUTE ON THE 7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
10. REFERENCES - H. J. RICHARDSON, FUGUE, NAA PROGRAM DESCRIPTION, MAY 1960.
R. C. NOYES, F. BERGONZOLI, AND J. E. GINGRICH, FUGUE, A NON-DIMENSIONAL METHOD FOR DIGITAL COMPUTER CALCULATION OF STEADY STATE TEMPERATURE, PRESSURE, AND VOID FRACTION IN PIPE FLOW WITH OR WITHOUT BOILING, NAA-SR-5958, 1961.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
H. J. RICHARDSON
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16. MATERIAL AVAILABLE -
SOURCE DECK (7090-440 CARDS)
REFERENCE REPORTS

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17. CATEGORY - I

KEYWORDS - COOLANTS, PRESSURE, TEMPERATURE, FLUID FLOW

1. NAME OR DESIGNATION OF PROGRAM - TEMPEST2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090,360, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - TEMPEST2 IS A NEUTRON THERMALIZATION PROGRAM BASED UPON THE WIGNER-WILKINS APPROXIMATION FOR LIGHT MODERATORS AND THE WILKINS APPROXIMATION FOR HEAVY MODERATORS. A MAXWELLIAN DISTRIBUTION MAY ALSO BE USED. THE MODEL USED MAY BE SELECTED AS A FUNCTION OF ENERGY. THE SECOND-ORDER DIFFERENTIAL EQUATIONS ARE INTEGRATED DIRECTLY RATHER THAN TRANSFORMED TO THE RICCATI EQUATION. THE PROGRAM PROVIDES MICROSCOPIC AND MACROSCOPIC CROSS SECTION AVERAGES OVER THE THERMAL NEUTRON SPECTRUM.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 1 TO 2 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - SOFOCATE, KATE
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
CDC1604 VERSION SUBMITTED MARCH 1964.
IBM360 VERSION SUBMITTED JUNE 1967.
10. REFERENCES - R. H. SHUDDE, TEMPEST-II, NAA PROGRAM DESCRIPTION, 1960, AND THREE SUPPLEMENTS 1960,61.
R. H. SHUDDE AND J. DYER, TEMPEST II - A NEUTRON THERMALIZATION CODE, AMTD-111, JUNE 1962.
R. H. SHUDDE, TEMPEST - CONVERSION OF A DECIMAL CROSS SECTION LIBRARY TO A BINARY CROSS SECTION LIBRARY, AMTD-112, NOVEMBER 1961.
R. H. SHUDDE, TEMPEST - A BINARY CROSS-SECTION LIBRARY READER, AMTD-113, NOVEMBER 1961.
R. H. SHUDDE, SOFOCATE LIBRARY TO TEMPEST LIBRARY CONVERTER, AMTD-114, NOVEMBER 1961.
R. H. SHUDDE, PREPARATION OF CROSS-SECTIONS FOR THE TEMPEST DECIMAL LIBRARY, AMTD-115, NOVEMBER 1961.
TEMPEST II, NOTES CONCERNING THE CONTROL DATA VERSION.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP (IBM7090), FORTRAN 63 (CDC1604), AND FORTRAN IV (IBM360)

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13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBSYS (7090) AND OS360 (360).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -

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1604	S. ELKIN NUCLEAR APPLICATIONS COMPUTATION CENTER CONTROL DATA CORPORATION COMPUTER DIVISION 3145 PORTER DRIVE P. O. BOX 10111 PALO ALTO, CALIFORNIA 94303
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
 SOURCE DECKS (7090-2145 CARDS, 1604-1076 CARDS, AND 360-1288 CARDS)
 SAMPLE PROBLEMS (7090-10 CARDS, 1604-11 CARDS, AND 360-15 CARDS)
 LIBRARIES (7090-765 CARDS, 1604-741 CARDS, AND 360-765 CARDS)
 REFERENCE REPORTS, NOTES
17. CATEGORY - B
 KEYWORDS - THERMALIZATION, WIGNER-WILKINS MODEL LIGHT MODERATORS,
 WILKINS EQUATION HEAVY MODERATORS, MAXWELL DISTRIBUTION, THERMAL SPECTRA

1. NAME OR DESIGNATION OF PROGRAM - FORM
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE FORM, OR FORTRAN-MUFT, PROGRAM IS A FOURIER TRANSFORM SLOWING-DOWN CODE. A LIBRARY TAPE CONTAINING 54-GROUP MICROSCOPIC CROSS SECTIONS, RESONANCE PARAMETERS, INELASTIC SCATTERING MATRICES, AND SOURCE SPECTRA IS USED TO GENERATE A 54-GROUP FLUX SPECTRUM AND FEW-GROUP CONSTANTS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - ABOUT 5 TO 6 SECONDS ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - MUFT, LIBRARY EDITING ROUTINES ARE INCLUDED AS AUXILIARY CODES.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
CDC1604 VERSION SUBMITTED MARCH 1964.
10. REFERENCES - D. J. MCGOFF, FORM, A FOURIER TRANSFORM FAST SPECTRUM CODE FOR THE IBM709, NAA-SR-MEMO-5766, 1960.
FORM, NOTES CONCERNING THE CONTROL DATA VERSION.
ATOMICS INTERNATIONAL FORM CROSS-SECTION LIBRARY,
AI NOTE, NOVEMBER 1962.
11. MACHINE REQUIREMENTS - 32K WITH 2 TAPE UNITS
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM) AND FORTRAN 63 (CDC)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
7090 R. A. BLAINE AND D. J. MCGOFF
ATOMICS INTERNATIONAL
P. O. BOX 309
CANDGA PARK, CALIFORNIA

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15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)
1604 S. ELKIN
NUCLEAR APPLICATIONS COMPUTATION CENTER
CONTROL DATA CORPORATION
COMPUTER DIVISION
3145 PORTER DRIVE
P. O. BOX 10111
PALO ALTO, CALIFORNIA 94303
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7090-1623 CARDS, 1604-1700 CARDS)
SAMPLE PROBLEMS (7090-15 CARDS, 1604-15 CARDS)
LIBRARIES (7090-5848 CARDS, 1604-5848 CARDS)
REFERENCE REPORT AND NOTES
17. CATEGORY - 8
KEYWORDS - FOURIER TRANSFORM SLOWING DOWN, FAST SPECTRA, FEW-
GROUP GROUP CONSTANTS

1. NAME OR DESIGNATION OF PROGRAM - SAIL .
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE MONOENERGETIC NEUTRON TRANSPORT EQUATION IS SOLVED USING THE DISCRETE SN METHOD FOR A ONE-DIMENSIONAL PLANE CELL. CELL PROPERTIES ARE COMPUTED.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
PLANE GEOMETRY
ORDER OF APPROXIMATION = 2, 4, 6, OR 8
1 ENERGY GROUP
MAXIMUM NUMBER OF REGIONS = 100
MAXIMUM NUMBER OF INTERVALS = 100
6. TYPICAL RUNNING TIME - THE RUNNING TIME IS GENERALLY LESS THAN ONE MINUTE. A SAMPLE S4 PROBLEM INVOLVING 7 MESH POINTS REQUIRED 21 SECONDS, INCLUDING LOADING THE PROGRAM INTO MEMORY.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
10. REFERENCES - B. J. LEMKE, SAIL, NAA PROGRAM DESCRIPTION, FEBRUARY 1961, AI-64-MEMO-179 PUBLICATION, AUGUST 1964.
B. CARLSON, NUMERICAL SOLUTION OF TRANSIENT AND STEADY-STATE NEUTRON TRANSPORT PROBLEMS, LA-2260, 1960.
SAIL, NOTES CONCERNING THE CONTROL DATA VERSION.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM), FORTRAN 63 (CDC)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
7090 B. J. LEMKE
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15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)

1604 S. ELKIN
NUCLEAR APPLICATIONS COMPUTATION CENTER
CONTROL DATA CORPORATION
COMPUTER DIVISION
3145 PORTER DRIVE
P. O. BOX 10111
PALO ALTO, CALIFORNIA 94303

16. MATERIAL AVAILABLE -

SOURCE DECKS (7090-962 CARDS, 1604-992 CARDS)
SAMPLE PROBLEMS (7090-17 CARDS, 1604-17 CARDS)
REFERENCE REPORT AND NOTES

17. CATEGORY - B

KEYWORDS - SN METHOD, CELL CALCULATION, 1-DIMENSIONAL, 1-GROUP,
SLABS, FLUX DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - S4 CYLINDRICAL GEOMETRY CELL CODE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM SOLVES THE ONE-DIMENSIONAL MONOENERGETIC BOLTZMANN EQUATION IN CYLINDRICAL GEOMETRY, USING THE S4 APPROXIMATION. IN ADDITION TO THE FLUX DISTRIBUTION, CELL-AVERAGED PARAMETERS ARE COMPUTED.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF REGIONS = 100
MAXIMUM NUMBER OF INTERVALS = 400
6. TYPICAL RUNNING TIME - ABOUT 15 SECONDS ARE REQUIRED FOR A 50 MESH POINT PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM - AN INPUT GUESS TO THE FLUX MAY BE PERFORMED TO PROVIDE AN INITIAL GUESS. IN ADDITION, WHEN RUNNING MULTIPLE CASES, THE CONVERGED FLUX FROM THE PREVIOUS CASE MAY BE USED.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
CDC1604 VERSION SUBMITTED MARCH 1964.
10. REFERENCES - J. S. TEMPLE, S4 CYLINDRICAL GEOMETRY CELL CODE, AMTD-104, SEPTEMBER 1961.
J. H. WARNER AND H. P. FLATT, S4 AND S8 CYLINDRICAL, AND S4 PLANE GEOMETRY CELL, N REGIONS CALCULATIONS, NAA PROGRAM DESCRIPTION ADDENDUM, JULY 1959.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM) AND FORTRAN 63 (CDC)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
7090 R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
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CANDOGA PARK, CALIFORNIA

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10/67

15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)

1604

S. ELKIN
NUCLEAR APPLICATIONS COMPUTATION CENTER
CONTROL DATA CORPORATION
COMPUTER DIVISION
3145 PORTER DRIVE
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PALO ALTO, CALIFORNIA 94303

16. MATERIAL AVAILABLE -

SOURCE DECKS (7090-414 CARDS AND 1604-454 CARDS)
REFERENCE REPORT AND ADDENDUM

17. CATEGORY - B

KEYWORDS - SN METHOD, CELL CALCULATION, 1-DIMENSIONAL, 1-GROUP,
CYLINDERS, FLUX DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - AIMFIRE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM WAS DESIGNED TO COMPARE THE COSTS OF VARIOUS FUEL CYCLES. THE PROGRAM CONTAINS A LIBRARY OF FAST AND THERMAL MICROSCOPIC CROSS SECTIONS, DECAY CONSTANTS, AND FISSION YIELDS FOR 50 ISOTOPES. THE PRESENT VERSION IS USED TO INVESTIGATE THE ECONOMICS OF URANIUM FUEL SYSTEMS.
4. METHOD OF SOLUTION - AIMFIRE USES NON-SPATIAL TWO-GROUP THEORY TO PREDICT K_{EFF} AS A FUNCTION OF BURNUP. OPTIONS ARE AVAILABLE BY WHICH CHANGES IN CERTAIN HETEROGENEOUS EFFECTS WITH BURNUP CAN BE TAKEN INTO ACCOUNT.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF ISOTOPES = 100
6. TYPICAL RUNNING TIME - ABOUT 2 SECONDS PER CYCLE ARE REQUIRED, EACH CYCLE DIVIDED INTO THREE PARTS.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
10. REFERENCE - R. A. BLAINE, AIMFIRE, A FUEL ECONOMICS CODE, NAA-SR-6706, 1961, AND ERRATA, NOVEMBER 20, 1961.
11. MACHINE REQUIREMENTS - 8K WITH 8 TAPE UNITS
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANDGA PARK, CALIFORNIA

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16. MATERIAL AVAILABLE -
SOURCE DECK (1250 CARDS)
SAMPLE PROBLEM (131 CARDS)
REFERENCE REPORT AND ERRATA
17. CATEGORY - D
KEYWORDS - FUEL CYCLE ECONOMICS, URANIUM, DEPLETION, 2-GROUP

1. NAME OR DESIGNATION OF PROGRAM - SUMMIT
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PROGRAM EVALUATES THE DIFFERENTIAL ENERGY-TRANSFER CROSS SECTION FOR SCATTERING BY A CRYSTALLINE MODERATOR, UTILIZING THE SO-CALLED PHONON EXPANSION. THE SCATTERING KERNEL FOR A 1-PHONON CHANGE IN ENERGY IS ADDED TO THAT FOR A 2-PHONON ENERGY EXCHANGE, AND SO ON. THIS PROGRAM HAS BEEN USED TO DETERMINE SCATTERING MATRICES FOR BERYLLIUM, GRAPHITE, AND OXYGEN.

$$\text{SIGMA}(E(0) \text{ TO } E)/\text{SIGMA}(0) = ((M+1)/M)^{1/2} * \text{SQRT}(E/E(0)) * 1/2$$
 THE INTEGRAL FROM -1 TO 1 OF $\text{SIGMA}(E(0) \text{ TO } E, \cos(\theta))$
 $\text{D}(\cos(\theta))$

WHERE $E(0)$ AND E ARE THE INITIAL AND FINAL ENERGIES, θ IS THE ANGLE OF SCATTERING, $\text{SIGMA}(0)$ THE FREE-ATOM CROSS SECTION, AND M THE RATIO OF THE MASS OF THE SCATTERING NUCLEUS TO THAT OF THE NEUTRON.

4. METHOD OF SOLUTION - THE GENERAL METHOD USED TO EVALUATE THE SCATTERING KERNEL INVOLVES TWO DIFFERENT EXPANSIONS. THE ONE THAT IS TO BE USED FOR GIVEN INITIAL AND FINAL ENERGIES AND FOR A GIVEN ANGLE OF SCATTERING IS DETERMINED BY THE MAGNITUDE OF THE FREE-ATOM RECOIL ENERGY, $(K \cdot K)/2M$. IF $(K \cdot K)/2M$ IS SMALLER THAN SOME QUANTITY WHICH IS CONTROLLED BY INPUT, WE USE THE PHONON EXPANSION. EACH OF THE FIRST $N(\text{PHO})$ TERMS IN THIS EXPANSION, WHERE $N(\text{PHO})$ IS AN INPUT NUMBER, IS COMPUTED BY NUMERICALLY PERFORMING THE CONVOLUTION INTEGRAL WHICH DETERMINES THE N -PHONON CROSS SECTION. THE TERMS OF ORDER N GREATER THAN $N(\text{PHO})$ ARE APPROXIMATED BY MEANS OF THE CENTRAL-LIMIT THEOREM. FOR LARGER VALUES OF $(K \cdot K)/2M$, WE USE THE SHORT-COLLISION-TIME APPROXIMATION FOR THE LOW-FREQUENCY MODES, MAKING THE PHONON EXPANSION ONLY FOR THE HIGH-FREQUENCY MODES. IN THIS CASE, THE CENTRAL-LIMIT THEOREM IS USED TO APPROXIMATE THE CONTRIBUTIONS FROM THE HIGH-FREQUENCY MODES FOR ALL VALUES OF N .
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME -

TYPE	NO. OF ENERGY POINTS	TEMP. (DEG. K)	TIME* (CENTIHR.)	NO. OF E(0) TO E
L-DEPENDENT ISOTROPIC	10 TO 0.50 EV	300	4.6	55
CRYSTAL	10 TO 0.50 EV	300	1.9	55

*TOTAL TIME TO LOAD * 36 SECONDS

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7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1962.
IBM7090 VERSION SUBMITTED MARCH 1962.
10. REFERENCES - JOAN BELL, SUMMIT - AN IBM-7090 PROGRAM FOR THE COMPUTATION OF CRYSTALLINE SCATTERING KERNELS, GA-2492, FEBRUARY 1962.
D. E. PARKS, THE CALCULATION OF THERMAL NEUTRON SCATTERING KERNELS IN GRAPHITE, GA-2438, OCTOBER 10, 1961.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
JOAN BELL
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3753 CARDS)
REFERENCE REPORT, GA-2492
17. CATEGORY - A
KEYWORDS - SCATTERING CROSS SECTIONS, CRYSTALS, MODERATORS, BERYLLIUM, OXYGEN, GRAPHITE

1. NAME OR DESIGNATION OF PROGRAM - SIZZLE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090,360, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - SIZZLE SOLVES THE ONE-DIMENSIONAL, OR MULTIGROUP BURNUP PROBLEM IN THE DIFFUSION THEORY APPROXIMATION FOR FAST INTERMEDIATE REACTORS. AFTER THE INITIAL CALCULATION AT T=0, AVERAGE CROSS SECTIONS ARE COMPUTED FOR FURTHER CALCULATIONS USING ONE TO SIX ENERGY GROUPS. CRITICALITY MAY BE MAINTAINED BY USE OF A CONCENTRATION SEARCH. THE CONCENTRATION OF THE VARIOUS ISOTOPES IS PERMITTED TO VARY ONLY FROM REGION-TO-REGION. CHAINS INCLUDED ARE TH232, U238, AND A FISSION PRODUCT POISON CHAIN.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THERE MUST BE NO MORE THAN 101 SPACE POINTS, 18 ENERGY GROUPS, OR 20 ELEMENTS. ONLY DOWNSCATTER IS PERMITTED, AND, IN THE CURRENT VERSION, NEUTRONS FROM A GIVEN GROUP ARE PERMITTED TO SCATTER ONLY TO A MAXIMUM OF FIVE SUCCESSIVE LOWER GROUPS.
6. TYPICAL RUNNING TIME - 4 MINUTES ARE REQUIRED FOR AN AVERAGE CASE ON THE IBM7090 AND 3 TO 10 MINUTES ON A 360 MODEL 50.
7. UNUSUAL FEATURES OF THE PROGRAM - CONCENTRATION SEARCH AND CRT (CATHODE RAY TUBE) OUTPUT ARE SPECIAL FEATURES OF SIZZLE.
8. RELATED AND AUXILIARY PROGRAMS - AIM6 (ACC ABSTRACT 29) AND THE AUXILIARY IBM360 MICROSCOPIC LIBRARY PROGRAM SIZLIB.
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1962.
IBM7090 VERSION SUBMITTED APRIL 1962.
CDC1604 VERSION SUBMITTED MARCH 1964.
IBM360 VERSION SUBMITTED MAY 1967.
10. REFERENCES - D. P. SATKUS AND H. P. FLATT, SIZZLE - A FAST OR INTERMEDIATE REACTOR BURN-UP CODE, NAA PROGRAM DESCRIPTION, FEBRUARY 1961, AI-64-MEMO-183 PUBLICATION, AUGUST 1964.
R. A. BLAINE, SIZLIB - CONVERSION TO IBM SYSTEM/360, VOLUMES I AND II, AI-66-MEMO-164, DECEMBER 1966.
R. A. BLAINE AND E. BRAMBLETT, SIZZLE - CONVERSION TO IBM SYSTEM/360, VOLUME I, AI-66-MEMO-165, DECEMBER 1966.
R. A. BLAINE, ATOMICS INTERNATIONAL ENVIRONMENT REPORT, MAY 1967.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (7090), FORTRAN 63 (1604), AND FORTRAN IV (360)

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13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
DS360 (360).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
THE SIZLIB PROGRAM PUNCHES A MICROSCOPIC CROSS SECTION LIBRARY IN
HEXADECIMAL FORM FOR USE IN CONJUNCTION WITH SIZZLE AND PRODUCES A
LISTING OF ITS CONTENTS. FLOW CHARTS FOR THE 360 VERSION OF SIZ-
ZLE AND SIZLIB ARE AVAILABLE FROM ACC ON A LOAN BASIS.
15. NAME AND ESTABLISHMENT OF AUTHORS -

7090,360	R. A. BLAINE SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT MATHEMATICS AND COMPUTER SCIENCES ATOMICS INTERNATIONAL P. O. BOX 309 CANOGA PARK, CALIFORNIA
1604	S. ELKIN NUCLEAR APPLICATIONS COMPUTATION CENTER CONTROL DATA CORPORATION COMPUTER DIVISION 3145 PORTER DRIVE P. O. BOX 10111 PALO ALTO, CALIFORNIA 94303
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECKS (SIZZLE 7090-5088 CARDS, 360-4415 CARDS, 1604-6459 CARDS)
SOURCE DECK (SIZLIB 360-256 CARDS)
OBJECT DECK (SIZZLE 360-2874 CARDS)
SAMPLE PROBLEM (SIZZLE 360-36 CARDS)
SAMPLE PROBLEM (SIZLIB 360-500 CARDS)
LIBRARIES (SIZZLE 7090-153 CARDS, 1604-588 CARDS)
REFERENCE REPORTS
17. CATEGORY - D
 KEYWORDS - DEPLETION, DIFFUSION EQUATIONS, 1-DIMENSIONAL, MULTI-
 GROUP, CRITICALITY SEARCHES, THORIUM232, URANIUM238,
 FISSION PRODUCTS, SIZLIB CODES

1. NAME OR DESIGNATION OF PROGRAM - MIST
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - MIST OBTAINS THE SOLUTION TO THE ONE-DIMENSIONAL BOLTZMANN EQUATION IN SLAB GEOMETRY. THE NUMERICAL APPROXIMATION USED IS A LINEAR ONE WHICH CAN BE DESCRIBED AS AN EXTENSION AND GENERALIZATION OF THE SN APPROXIMATION. THE EQUATIONS ARE FORMULATED IN TERMS OF A DOUBLE SN APPROXIMATION. THE BOUNDARY CONDITIONS FOR EACH GROUP MAY BE INDEPENDENTLY SPECIFIED AND PERMIT VERY GENERAL SPECIFICATIONS WITH RESPECT TO -
 - (A) PERFECT MIRROR REFLECTION OR SYMMETRY, BY INPUT OF MIRROR ALBEDOS,
 - (B) ANISOTROPIC DIFFUSE SOURCES, BY INPUT OF LEGENDRE POLYNOMIAL COEFFICIENTS UP TO $\lambda = 9$, OR A SHORT TABLE DESCRIBING A KNOWN ANGULAR DISTRIBUTION OF THE FLUX,
 - (C) ISOTROPIC (LAMBERT SURFACE) REFLECTION.
 ISOTROPIC VOLUME SOURCES IN EACH GROUP MAY ALSO BE INDEPENDENTLY SPECIFIED. THE SCATTERING FROM ONE GROUP TO ANOTHER IS ASSUMED TO BE ISOTROPIC BUT THE SCATTERING FUNCTION WITHIN EACH GROUP CAN BE A SECOND-ORDER LEGENDRE POLYNOMIAL SERIES.
4. METHOD OF SOLUTION - THE ANGULAR FLUXES FOR A GROUP ARE OBTAINED BY A DIRECT SOLUTION OF THE MATRIX PROBLEM. HENCE, NO INNER ITERATIONS ARE REQUIRED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - IN ORDER TO MAINTAIN THE MAXIMUM FLEXIBILITY, THE MIST PROGRAM IS DIVIDED INTO FOUR SEPARATE CODES. THE LIMIT ON THE NUMBER OF SPATIAL AND MESH POINTS FOR EACH CODE IS AS FOLLOWS -

CODE	MAXIMUM NUMBER OF	
	ANGULAR INTERVALS	SPACE POINTS
MIST 4	4	250
MIST 6	6	150
MIST 8	8	100
MIST 10	10	70
MAXIMUM NUMBER OF ENERGY GROUPS		6
MAXIMUM NUMBER OF REGIONS		40
MAXIMUM NUMBER OF MATERIALS		40
MAXIMUM NUMBER OF DOWNSCATTER GROUPS		5

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6. TYPICAL RUNNING TIME - 2 GROUP, 69 POINT PROBLEM REQUIRING SIX OUTER ITERATIONS TO POINTWISE CONVERGENCE OF 0.001 -
ANGULAR INTERVALS	TIME (MINUTES)
2	0.58
4	1.03
6	1.68
8	2.52
10	3.56

PROBLEMS WHICH REQUIRE NO OUTER ITERATIONS WILL TAKE A MAXIMUM OF APPROXIMATELY ONE MINUTE.

7. UNUSUAL FEATURES OF THE PROGRAM - BECAUSE ONLY OUTER ITERATIONS ARE REQUIRED FOR THE SOLUTION OF A USUAL EIGENVALUE PROBLEM (AS IN AN ORDINARY DIFFUSION THEORY CODE), THE PROGRAM IS PARTICULARLY EFFICIENT ON MOST THERMAL REACTOR PROBLEMS OR MODERATOR REFLECTED SYSTEMS WHICH TYPICALLY INVOLVE LARGE REGIONS OF LOW ABSORBING MATERIALS.
8. RELATED AND AUXILIARY PROGRAMS - TOPIC (ACC ABSTRACT 148), A CYLINDRICAL GEOMETRY SN CODE, USES THE MIST CODE SOLUTION METHOD TO SPEED THE CONVERGENCE OF THE MORE COMPLICATED CYLINDRICAL PROBLEM.
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1962.
IBM7090 VERSION SUBMITTED NOVEMBER 1962.
10. REFERENCE - D. M. SHAPIRO AND G. E. PUTNAM, MIST (MULTIGROUP INTERNUCLEAR SLAB TRANSPORT), IDO-16856, MAY 1963.
11. MACHINE REQUIREMENTS - 32K WITH 5 TAPE UNITS AND A CLOCK
12. PROGRAMMING LANGUAGE USED - FORTRAN II EXCEPT FOR THE CLOCK ROUTINE WHICH IS WRITTEN IN FAP
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD FORTRAN MONITOR SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
G. E. PUTNAM
ATOMIC ENERGY DIVISION
PHILLIPS PETROLEUM COMPANY
IDAHO FALLS, IDAHO 83401
16. MATERIAL AVAILABLE -
SOURCE DECK (1797 CARDS)
SAMPLE PROBLEM (41 CARDS)
REFERENCE REPORT
17. CATEGORY - C
KEYWORDS - TRANSPORT THEORY, 1-DIMENSIONAL, SLABS, MULTIGROUP, FLUX DISTRIBUTION, REACTIVITY

1. NAME OR DESIGNATION OF PROGRAM - LOS ALAMOS LEAST SQUARES
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM PERFORMS LEAST SQUARES FITTING OF LINEAR OR NONLINEAR FUNCTIONS IN SEVERAL INDEPENDENT VARIABLES. THE PROGRAM WILL DETERMINE AN ESTIMATE OF A IN THE FUNCTION $Y=F(X,A)$ BY MINIMIZING THE SUM OF SQUARES. IN THE FUNCTION, X IS A VECTOR OF OBSERVED VARIABLES AND A IS A VECTOR OF PARAMETERS TO BE DETERMINED. IN THIS CONTEXT, A LINEAR FUNCTION IS ONE WHOSE PARTIAL DERIVATIVES WITH RESPECT TO THE ELEMENTS OF A ARE ALL INDEPENDENT OF A. A NONLINEAR FUNCTION HAS AT LEAST ONE OF THE ELEMENTS OF A APPEARING IN AT LEAST ONE OF THESE PARTIAL DERIVATIVES.
4. METHOD OF SOLUTION - THE ITERATIVE METHOD OF GAUSS (SOMETIMES CALLED THE GAUSS-SEIDEL METHOD) IS USED. THE FUNCTION IS EXPANDED WITH RESPECT TO A IN A FIRST-ORDER TAYLOR'S SERIES ABOUT SOME POINT A(0). A VECTOR OF CORRECTIONS, SAY D, IS OBTAINED BY MULTIPLE REGRESSION METHODS AND A NEW ESTIMATE $A(1)=A(0)+D$ IS OBTAINED. THE PROCESS IS REPEATED UNTIL THE VECTOR D IS SUFFICIENTLY SMALL. THE FUNCTION AND ITS DERIVATIVES WITH RESPECT TO THE PARAMETERS ARE SUPPLIED TO THE PROGRAM BY THE USER BY MEANS OF A SUBROUTINE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - AS ORIGINALLY CONCEIVED, THE PROGRAM WAS WRITTEN FOR A 32K MEMORY AND WOULD HANDLE UP TO 500 DATA POINTS, UP TO 5 INDEPENDENT VARIABLES, AND UP TO 20 PARAMETERS. IN ITS CURRENT VERSION IT HANDLES 1000 DATA POINTS, 5 INDEPENDENT VARIABLES, AND 40 PARAMETERS. DIFFERENT VERSIONS OF THE CODE ARE WRITTEN FOR VARIOUS MEMORY SIZES, 8K IS USUALLY SUFFICIENT, BUT IT CAN BE SCALED TO 4K. NO RESTRICTIONS HAVE SO FAR BEEN ENCOUNTERED AS TO THE NATURE OR COMPLEXITY OF THE FUNCTION AS LONG AS NO DISCONTINUITIES EXIST IN THE FUNCTION OR ITS DERIVATIVES OVER THE RANGE OF USEFULNESS, I.E., THE DATA MUST BE PHYSICALLY SIGNIFICANT, WELL-BEHAVED, AND REASONABLY DESCRIBE THE FUNCTION TO BE FITTED. ON THE LASL 7094, UNDERFLOW IS AUTOMATICALLY SET TO ZERO, AND THE CODE DOES NOT CHECK UV-OV CONDITIONS.
6. TYPICAL RUNNING TIME - FROM 5 SECONDS TO 5 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM - A DAMPING FACTOR IS INTRODUCED TO HELP CONTROL NONCONVERGENT OSCILLATIONS. ESTIMATES OF THE STANDARD DEVIATION OF ALL PARAMETERS ARE INCLUDED WITH THE SOLUTIONS. ANY (OR ALL) PARAMETERS MAY BE HELD AT CONSTANT VALUES. ARBITRARY WEIGHTING OF THE OBSERVATIONS Y IS PERMITTED. THE PROGRAM PACKAGE IS SUBROUTINE-IZED SO THAT ITS VARIOUS PARTS ARE EASILY MODIFIED OR INCORPORATED INTO OTHER PROGRAMS.
8. RELATED AND AUXILIARY PROGRAMS -

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9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1962.
IBM7094 VERSION SUBMITTED MAY 1965.
10. REFERENCES - R. H. MOORE AND R. K. ZIEGLER, THE SOLUTION OF THE
GENERAL LEAST SQUARES PROBLEM WITH SPECIAL REFERENCE TO HIGH-
SPEED COMPUTERS, LA-2367, OCTOBER 5, 1959.
P. MCWILLIAMS, USERS GUIDE NON-LINEAR LEAST SQUARES
PROGRAM, JANUARY 1, 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY WITH TAPE 10 USED FOR INPUT AND
9 FOR OUTPUT
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM7094 IBSYS, VERSION 13.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
ROGER H. MOORE
LOS ALAMOS SCIENTIFIC LABORATORY
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO
16. MATERIAL AVAILABLE -
SOURCE DECK (2604 CARDS)
REFERENCE REPORTS
17. CATEGORY - P
KEYWORDS - LEAST SQUARES, NONLINEAR, DATA PROCESSING

1. NAME OR DESIGNATION OF PROGRAM - GE-HAPO-S13
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - PROGRAM S CONSTRUCTS BILINEARLY COUPLED TIME-VARIANT MULTIENERGY NEUTRON-AND-PHOTON TRANSPORT AND NUCLIDE-TRANSMUTATION FIELDS HAVING SLAB, CYLINDRICAL, OR SPHERICAL SYMMETRY. ASSURANCE OF UNBIASED CONVERGENCE IS PROVIDED BY USE OF A DUAL ADJOINT-AND-FLUX LOOP CONSTRUCTED IN PRECISE CORRESPONDENCE WITH THE PHYSICS OF SUCCESSIVE FREE FLIGHTS.
4. METHOD OF SOLUTION -
 - (A) TRANSPORT METHOD (INNER LOOP) - VARIATIONAL OPTIMUM LOGIC REVOLVING ABOUT INTEGRATED ACTION PRINCIPLE. NEXT-FREE-FLIGHT ADJOINT LOOP LOCKED IN MOMENTUM-IMAGE SYNCHRONISM WITH LAST-FREE-FLIGHT FLUX LOOP. DOUBLE SN DOUBLY-RULED-SURFACE DIGITAL REPRESENTATION AND LATTICE INTEGRATION, WITH THREE-PASS ALBEDO LOOP AND NUMERICAL STABILITY OPTIMIZATION. PERTURBATION-THEORY CONVERGENCE ACCELERATION FOR EIGENVALUE, ADJOINT, AND FLUX, USING TWO-CHANNEL-PARALLEL-LOGIC FIELD SHUTTLE. FULL USE OF ROUNDING TO MINIMIZE TRUNCATION BIAS ACCRUAL. PARALLEL-LOGIC ERROR-TRAP CONTROL ON ALL INPUT-OUTPUT TRANSMISSION AND ON ALL CALCULATIONS. EXHAUSTIVE INPUT-OUTPUT VERSATILITY, DESIGNED TO SPAN NEEDS OF BOTH ENGINEER AND PHYSICIST.
 - (B) TRANSMUTATION METHOD (OUTER LOOP) - SLOW BILINEAR SPECTRAL SHIFT PERTURBATION OF RAPIDLY-VARIANT MATRIX-EXPONENTIAL FINE STRUCTURE. UNCONDITIONALLY STABLE EVALUATION OF MATRIX EXPONENTIAL BY SCALING SUM OF SQUARES OF ELEMENTS TO LESS THAN ONE, SUMMING SCALED-MATRIX POWER SERIES TO SOLID CONVERGENCE, AND UNSCALING SUM BY MATRIX-EXPONENTIAL RECURSION. UNRESTRICTED TRANSMUTATION INTRICACY (SPONTANEOUS AND INDUCED, ENDOERGIC AND EXOERGIC, DECAYING AND MULTIPLYING, BRANCHING AND CYCLIC), WITH INCLUSION OF ENERGY-VARIANT INDUCED-YIELD FRACTIONS. REGION SHEARS OR FINE DETAIL. INTRINSIC TIME-REVERSAL ADEQUACY EVALUATION.
 - (C) INPUT ARE TIME-SPACE-ENERGY-ANGLE LATTICE SHAPE TRANSFORMATION, CONCENTRATIONS, CROSS SECTIONS (COLLISION, FISSION PRODUCTION, ISOTROPIC-AND-ANISOTROPIC ENDOERGIC-AND-EXOERGIC ATTENUATIVE-AND-MULTIPLICATIVE TRANSFER, PRODUCTION, INDUCED TRANSMUTATION YIELDS, SENSOR), SPONTANEOUS TRANSMUTATION RATES, SURFACE ALBEDOS, ISOTROPIC AND ANISOTROPIC POINT-LINE-SURFACE-VOLUME SOURCES, CROSS SECTION UNCERTAINTIES.
 - (D) OUTPUT INCLUDES ADJOINT AND FLUX TIME-SPACE-ENERGY-ANGLE DISTRIBUTION, EIGENVALUE (CRITICAL MATERIAL LOADING, CRITICAL SHAPE DEFORMATION, REACTOR PERIODS WITH INCLUSION OF DELAYED PRODUCTION), ACTION BALANCE, ACTION TRENDS, VARIATIONAL OPTIMUM KINETIC NORMAL MODES, PERTURBED EIGENVALUES, MATERIAL ACTION TRAVERSES, EIGENVALUE UNCERTAINTY, ENERGY DISTRIBUTIONS, POWER TRAVERSE, ABSORPTION TRAVERSE,

4. METHOD OF SOLUTION (CONTINUED)
MODERATION ENERGY DEPOSITION TRAVERSE, BIOLOGICAL DOSE TRAVERSE, MATERIAL RADIATION-DAMAGE TRAVERSES, ISOTROPIC AND ANGULAR SENSOR ACTIVATION TRAVERSES, SPACE-ENERGY DISTRIBUTIONS, VARIATIONAL OPTIMUM SPACE-ENERGY-MATERIAL SMEARS, PRODUCTION DISTRIBUTIONS, PERTURBATION INTEGRALS, REACTION-RATE INTEGRALS, RESTART FIELD, ISOTOPE CONCENTRATIONS AND TRENDS, TRANSMUTATION RATES AND WORTHS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM. -
6. TYPICAL RUNNING TIME - TYPICALLY 5 TO 20 MINUTES ARE REQUIRED FOR A 4-FIGURE EIGENVALUE FROM A FLAT-FIELD START, WITH AN ADDITIONAL 1 TO 5 MINUTES FOR EACH SIGNIFICANT-SPECTRAL-SHIFT TRANSMUTATION EXPOSURE.
7. UNUSUAL FEATURES OF THE PROGRAM - TRANSPORT METHOD HAS WELL-EVALUATED RELIABILITY (LIMITED PRINCIPALLY BY CROSS SECTION ACCURACY) SPANNING BOTH NEUTRON AND PHOTON ASPECTS OF CORE, REFLECTOR, CONTROL-ROD AND INNER-SHIELD ANALYSIS OF COMPACT FISSION REACTORS. TRANSMUTATION METHOD OPTIMAL FOR HIGH-EXPOSURE BREEDER CYCLES.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1962.
GE-HAPD-S10 VERSION SUBMITTED JUNE 1962, DELETED SEPTEMBER 1964.
GE-HAPD-S12 VERSION SUBMITTED SEPTEMBER 1964, DELETED APRIL 1966.
GE-HAPD-S13 VERSION SUBMITTED APRIL 1966.
10. REFERENCES - B. H. DUANE, NEUTRON AND PHOTON TRANSPORT, GE-ANPD-XDC 59-9-118, JANUARY 1959, AND INSERT.
B. H. DUANE, SYMBOLIC MATRIX TRANSLATOR, GE-ANPD-APEX 618, MARCH 1961.
B. H. DUANE, ALBEDO LOGIC FOR DOUBLE-SIN TRANSPORT ANALYSIS, EXTRACT FROM PHYSICS RESEARCH QUARTERLY REPORT, HW-71747, JULY-SEPTEMBER 1962.
B. H. DUANE, TRANSPORT THEORY DEVELOPMENT WORK, EXTRACT FROM PHYSICS RESEARCH QUARTERLY REPORT, HW-76128, OCTOBER-DECEMBER 1962.
B. H. DUANE, CRITICAL METRIC TENSOR, EXTRACT FROM PHYSICS RESEARCH QUARTERLY REPORT, HW-77311, JANUARY-MARCH 1963.
B. H. DUANE, TIME-VARIANT ISOTOPIC TRANSMUTATION GE-HL PROGRAM ALCHEMY, EXTRACT FROM PHYSICS RESEARCH QUARTERLY REPORT, HW-80020, OCTOBER-DECEMBER 1963.

11. MACHINE REQUIREMENTS - LOAD-AND-GO DECK INCLUDES LOADER, FLOCO-V COMPILER AND TRANSMITTER, PROGRAM S, AND OPERATOR LINKAGE DESIGNED TO FIT ANY 6-TAPE 2-CHANNEL 32K IBM7090 SYSTEM WITHOUT MODIFICATION. TAPE UNIT ASSIGNMENTS ARE -
A1	FORTRAN II MONITOR
A2	INPUT
A3	OUTPUT (LIST)
B4	OUTPUT (PUNCH)
A4 AND B3	STORAGE (IF FIELD ACCELERATION)
12. PROGRAMMING LANGUAGE USED - FLOCO5
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN II MONITOR
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - LOAD-AND-GO DECK IS USED AS THOUGH IT WERE A FORTRAN II PROGRAM.
15. NAME AND ESTABLISHMENT OF AUTHOR -
- B. H. DUANE
BATTELLE-NORTHWEST
PACIFIC NORTHWEST LABORATORY
P. O. BOX 999
RICHLAND, WASHINGTON 99352
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
OBJECT DECK AND FLOCO5 TEST CASE (FILE 1-669 CARDS)
ANALYSIS ABSTRACT AND INPUT INSTRUCTIONS (FILE 2-439 CARDS)
SOURCE DECK - PROGRAM S13 (FILE 3-1310 CARDS)
SOURCE DECK - FLOCO5 (FILE 4-1858 CARDS)
REFERENCE REPORTS (ALL EXCEPT GE-ANPD-APEX 618)
17. CATEGORY - C
KEYWORDS - TRANSPORT THEORY, 1-DIMENSIONAL, SLABS, CYLINDERS, SPHERES, REACTIVITY

REACTOR CODE ABSTRACT B7

10/67

1. NAME OR DESIGNATION OF PROGRAM - EQUIPOISE-3A
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - EQUIPOISE-3A SOLVES THE TWO-DIMENSIONAL TWO-GROUP DIFFUSION EQUATIONS IN CYLINDRICAL OR SLAB GEOMETRY. IT IS A SLIGHTLY REVISED VERSION OF EQUIPOISE3 (ACC ABSTRACT 39). IN ADDITION TO THE STANDARD OUTPUT, A PICTURE IS PRINTED OF THE MATERIAL ARRANGEMENT IN THE REACTOR. IF THE ADJOINT FLUX OPTION IS USED, THE PROMPT NEUTRON LIFETIME IS CALCULATED AND PRINTED, WITH THE REACTIVITY PER UNIT CHANGE IN EACH GROUP CONSTANT IN EACH REGION OF THE REACTOR.
4. METHOD OF SOLUTION - THE METHOD USED IS THE SAME AS THAT USED IN EQUIPOISE3.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - SAME AS FOR EQUIPOISE3 WITH THE EXCEPTION THAT IF THE NUMBER OF DIFFERENT MATERIALS IN THE REACTOR EXCEEDS 35 NO PICTURE WILL BE PRINTED.
6. TYPICAL RUNNING TIME - APPROXIMATELY 0.0017 SECOND PER POINT PER ITERATION IS REQUIRED, ABOUT 5 MINUTES FOR A 1000-POINT PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM - FOR USE IN CHECKING INPUT DATA, MESH POINTS NOT COVERED BY A MATERIAL ARE FLAGGED WITH AN ASTERISK IN THE PICTURE.
8. RELATED AND AUXILIARY PROGRAMS - EQUIPOISE3
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1963.
IBM7090 VERSION SUBMITTED NOVEMBER 1962.
10. REFERENCES - T. B. FOWLER AND M. L. TOBIAS, EQUIPOISE-3, A TWO-DIMENSIONAL, TWO-GROUP NEUTRON DIFFUSION CODE FOR THE IBM-7090 COMPUTER, ORNL-3199, DECEMBER 1959.
C. W. NESTOR, JR., EQUIPOISE-3A, ORNL-3199, ADDENDUM, JUNE 1962.
NOTE, CONTROL DATA VERSION OF EQUIPOISE III A.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM) AND FORTRAN 63 (CDC)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

7090

C. W. NESTOR, JR., T. B. FOWLER,
AND M. L. TOBIAS
OAK RIDGE NATIONAL LABORATORY
P. O. BOX X
OAK RIDGE, TENNESSEE 37831

1604

S. ELKIN
NUCLEAR APPLICATIONS COMPUTATION CENTER
CONTROL DATA CORPORATION
COMPUTER DIVISION
3145 PORTER DRIVE
P. O. BOX 10111
PALO ALTO, CALIFORNIA 94303

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECKS (7090-2526 CARDS, 1604-2590 CARDS)

SAMPLE PROBLEMS (7090-13 CARDS, 1604-18 CARDS)

REFERENCE REPORTS AND NOTE

17. CATEGORY - C

KEYWORDS - DIFFUSION EQUATIONS, 2-DIMENSIONAL, 2-GROUP, SLABS,
CYLINDERS, REACTIVITY, FLUX DISTRIBUTION, LIFETIME

REACTOR CODE ABSTRACT 89

10/67

1. NAME OR DESIGNATION OF PROGRAM - ARES2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - ARES2 IS USED TO CALCULATE EFFECTIVE RESONANCE INTEGRALS AND MULTIGROUP CROSS SECTIONS FOR LUMPS AND MIXTURES USING RESONANCE PARAMETERS. IT COMBINES IN A SINGLE CODE, THE RESOLVED, UNRESOLVED, AND 1/V PARTS OF THE CALCULATION WHICH WERE PREVIOUSLY IN SEPARATE CODES. THE MULTIGROUP CROSS SECTIONS ARE PRINTED IN A FORM FOR USE IN MULTIGROUP REACTOR CALCULATIONS. FOR EXAMPLE, THEY CAN BE INSERTED INTO THE AIM6 (ACC ABSTRACT 29) OR FAIM (ACC ABSTRACT 120) LIBRARIES. THE ENERGY BREAKPOINTS ARE INPUT DATA AND A RESONANCE PARAMETER LIBRARY IS INCLUDED.
4. METHOD OF SOLUTION - ARES2 USES THE METHODS OF CHERNICK AND VERNON AND COHEN AND GOLDSTEIN.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF GROUPS = 50
6. TYPICAL RUNNING TIME - 15 SECONDS ARE REQUIRED ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
CDC1604 VERSION SUBMITTED MARCH 1964.
10. REFERENCES - F. L. FILLMORE, ARES-1, A RESONANCE INTEGRAL CODE, AMTD-130, MAY 1962.
ARES-1, NOTES CONCERNING THE CONTROL DATA VERSION.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM) AND FORTRAN 63 (CDC)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
7090 R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA

15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)

1604

S. ELKIN

NUCLEAR APPLICATIONS COMPUTATION CENTER

CONTROL DATA CORPORATION

COMPUTER DIVISION

3145 PORTER DRIVE

P. O. BOX 10111

PALO ALTO, CALIFORNIA 94303

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECKS (7090-1014 CARDS AND 1604-1016 CARDS)

SAMPLE PROBLEMS (7090-12 CARDS AND 1604-12 CARDS)

LIBRARIES (7090-472 CARDS AND 1604-472 CARDS)

REFERENCE REPORT AND NOTES

17. CATEGORY - A

KEYWORDS - RESONANCE INTEGRALS, MULTIGROUP CROSS SECTION, RESOLVED
REGION, UNRESOLVED REGION

REACTOR CODE ABSTRACT 91

10/67

1. NAME OR DESIGNATION OF PROGRAM - FARSE-1A
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PROGRAM COMPUTES THE NEUTRON LEAKAGE FROM A SHIELD ANNULUS. THE REMOVAL CROSS SECTIONS INCORPORATE MULTISCATTERING EFFECTS. DOSE DEPOSIT AT THE TARGET MESH IS THEN DETERMINED FROM THE ANGULAR DISTRIBUTION OF THE LEAKAGE NEUTRONS, INTEGRATED OVER THE SHIELD SURFACE.
4. METHOD OF SOLUTION - AN ATTENUATION MODEL BASED ON MEAN FREE PATHS TRAVERSED ALONG A STRAIGHT LINE TRAJECTORY IS USED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - SNAP GEOMETRY IS IMPLICIT IN THIS CODE.
6. TYPICAL RUNNING TIME - 1 MINUTE IS REQUIRED ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1963.
IBM7090 VERSION SUBMITTED DECEMBER 1962.
10. REFERENCES - K. L. RODNEY AND M. A. BOLING, FARSE-1A, A MODIFICATION OF FARSE TO INCLUDE ANGULAR DEPENDENCE OF SHIELD LEAKAGE, NAA-TDR-5954, DECEMBER 1960.
K. L. RODNEY AND M. A. BOLING, FARSE, A FIRST ORDER APPROXIMATION OF REACTOR SHIELDS FOR SNAP SYSTEMS, PART 1 - NON-SCATTERED DOSE, EXTRACT FROM NAA-TDR-5772, OCTOBER 11, 1960.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
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P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (614 CARDS)
REFERENCE REPORTS

REACTOR CODE ABSTRACT 91

-2-

10/67

17. CATEGORY - J

KEYWORDS - ANGULAR DISTRIBUTION LEAKAGE NEUTRONS, SHIELDING,
ANNULAR SPACE, SNAP REACTORS

REACTOR CODE ABSTRACT 99

10/67

1. NAME OR DESIGNATION OF PROGRAM - DUO DIMENSIONAL BURNOUT (DDB)
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE FIVE-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL GEOMETRY ARE SOLVED WITH BURNOUT OPTIONS AND CONTROL ROD SEARCH OPTIONS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THIS VERSION OF DDB HAS BEEN WRITTEN IN R-Z GEOMETRY WITH NO INTERNAL NON-DIFFUSION REGIONS. THE PRINCIPAL LIMITATIONS CONSIST OF THE FOLLOWING UPPER LIMITS -
 - 4000 MESH POINTS
 - 5 ENERGY GROUPS
 - 300 REGIONS
 - 80 INDIVIDUAL ISOTOPIC SPECIES
 - 10 REGION SETS - ESSENTIALLY THIS MEANS 10 COMPLETE CROSS SECTION LIBRARIES
 - 40 ISOTOPES IN EACH REGION SET
 - 20 TABLES OF SHIELDING FACTORS AS FUNCTIONS OF LUMP CONCENTRATION
 - 1 DIRECT CAPTURE PRODUCT FOR EACH ISOTOPIC SPECIE
 - 1 DIRECT $n,2n$ PRODUCT FOR EACH ISOTOPIC SPECIE
 - 12 DIRECT FISSION PRODUCTS FOR EACH ISOTOPIC SPECIE
 - 2 DIRECT DECAY PRODUCTS FOR EACH ISOTOPIC SPECIE

SCATTERING DOWN ONE GROUP FROM GROUPS 1, 2, 3, 4. SCATTERING DOWN TWO GROUPS FROM GROUP 3, AND SCATTERING UP ONE GROUP FROM GROUP 5. FISSION SOURCE SPECTRUM INDEPENDENT OF INCIDENT ENERGY AND FISSIONING ISOTOPE.
6. TYPICAL RUNNING TIME - APPROXIMATELY 0.0028 SECOND PER MESH POINT PER ITERATION PER GROUP IS REQUIRED. A TYPICAL LARGE DIFFUSION AND CONTROL ROD SEARCH PROBLEM RUNS IN ABOUT 30 MINUTES. MAXIMUM BURNOUT PROBLEMS RUN ABOUT 15 TO 20 MINUTES PER TIME-STEP INCLUDING CONTROL ROD POSITIONING.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1963.
IBM7090 VERSION SUBMITTED JANUARY 1963.
10. REFERENCE - J. H. ALEXANDER, C. CYL-CHAMPLIN, J. E. GRATTEAU, W. A. GROWDEN, P. C. KAESTNER, AND E. J. LESHAN, DDB - A TWO-DIMENSIONAL REACTOR DIFFUSION CODE WITH CRITICALITY SEARCH AND BURNOUT OPTIONS, GAMD-2797, MARCH 15, 1962.

11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
J. H. ALEXANDER, C. CYL-CHAMPLIN,
J. E. GRATTEAU, W. A. GROWDEN,
P. C. KAESTNER, AND E. J. LESHAN
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (2 TAPES)
SOURCE DECK (TAPE A AND TAPE B 1ST FILE)
BINARY DECK AND SAMPLE PROBLEM (TAPE B 2ND FILE)
SAMPLE PROBLEM OUTPUT (TAPE B 3RD FILE)
REFERENCE REPORT, VOLUME 1
17. CATEGORY - D
KEYWORDS - DEPLETION, DIFFUSION EQUATIONS, 2-DIMENSIONAL, FEW-
GROUP, R-Z, CONTROL ROD SEARCHES

REACTOR CODE ABSTRACT 102

10/67

1. NAME OR DESIGNATION OF PROGRAM - AX1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - AX1 PERFORMS A COUPLED NEUTRONICS-HYDRODYNAMICS CALCULATION. GIVEN A SPHERICALLY SYMMETRIC, SUPERPROMPT CRITICAL SYSTEM, THE PROGRAM COMPUTES THE VARIATION IN TIME AND SPACE OF THE SPECIFIC ENERGY, TEMPERATURE, PRESSURE, DENSITY AND VELOCITY.
4. METHOD OF SOLUTION - A SPHERICAL ASSEMBLY IS DIVIDED INTO SPHERICAL SHELLS OR MASS POINTS. THE NEUTRONICS OF THIS SYSTEM IS CALCULATED USING AN S4 APPROXIMATION TO PROVIDE AN ALPHA (THE INVERSE PERIOD OF REACTIVITY) AS WELL AS A POWER DISTRIBUTION ACROSS THE RADIAL NETWORK. IN THE HYDRODYNAMICS PORTION OF THE CODE NEW VELOCITIES AND MASS POINT POSITIONS ARE COMPUTED AND IN THE THERMODYNAMICS SECTION NEW PRESSURES ARE CALCULATED FROM THE EQUATION OF STATE. WHEN THE COMPUTATION OF THE THERMO- AND HYDRO-DYNAMIC CHANGES DURING A SPECIFIED TIME INTERVAL IS COMPLETE (A HYDROCYCLE), A SERIES OF TESTS ARE RUN AND THE PROGRAM EITHER PROCEEDS WITH ANOTHER HYDROCYCLE OR GOES BACK TO THE NEUTRONICS CALCULATION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF MASS POINTS = 39
 - MAXIMUM NUMBER OF GROUPS = 7
 - MAXIMUM NUMBER OF MATERIALS = 8
 - MAXIMUM NUMBER OF MIXTURES = 8
6. TYPICAL RUNNING TIME - 10 MINUTES ARE REQUIRED FOR A 2 REGION, 1 GROUP PROBLEM WITH 39 MASS POINTS AND A 0.00005 CONVERGENCE CRITERION FOR ALPHA. RUNNING TIME IS SENSITIVE TO THIS CRITERION SINCE IT CONTROLS THE OFT-REPEATED ALPHA CALCULATION.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
 - IBM704 VERSION SUBMITTED MARCH 1963 BY ANL, DELETED OCTOBER 1967.
 - CDC3600 VERSION SUBMITTED JULY 1967, SAMPLE PROBLEM EXECUTED BY ACC.
10. REFERENCES - D. OKRENT, J. M. COOK, D. SATKUS, R. B. LAZARUS, AND M. B. WELLS, AX-1, A COMPUTING PROGRAM FOR COUPLED NEUTRONICS-HYDRODYNAMICS CALCULATIONS ON THE IBM 704, ANL-5977, MAY 1959.
 - U6 CODA AX-1, CDC PROGRAMMING NOTE.
11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
SCOPE.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
AX1 SHOULD BE RUN WITH TAPE 6 BYPASSED OR DISTINCT FROM THE
STANDARD OUTPUT TAPE, AND WITH ALL SENSE SWITCHES OFF.
15. NAME AND ESTABLISHMENT OF AUTHOR -
S. ELKIN
NUCLEAR APPLICATIONS COMPUTATION CENTER
CONTROL DATA CORPORATION
COMPUTER DIVISION
3145 PORTER DRIVE
P. O. BOX 10111
PALO ALTO, CALIFORNIA 94303
16. MATERIAL AVAILABLE -
SOURCE DECK (587 CARDS)
BINARY DECK (210 CARDS)
SAMPLE PROBLEM (64 CARDS)
REFERENCE REPORT AND NOTE
17. CATEGORY - F
KEYWORDS - HYDRODYNAMICS, THERMODYNAMICS, SN METHOD, SPACE-TIME
DISTRIBUTION, TEMPERATURE, PRESSURE, VELOCITY, 1-DIMEN-
SIONAL, SPHERES, REACTIVITY

REACTOR CODE ABSTRACT 103

10/67

1. NAME OR DESIGNATION OF PROGRAM - CRAM
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - CRAM IS A PROGRAM TO SOLVE THE MULTIGROUP DIFFUSION EQUATIONS IN TWO-DIMENSIONS (R-Z, X-Y, OR R-THETA GEOMETRY), OR IN ONE-DIMENSION (SLAB, CYLINDRICAL, OR SPHERICAL GEOMETRY). NEUTRONS MAY SCATTER FROM ANY GROUP TO ANY OTHER. REAL, ADJOINT, AND SOURCE-TYPE PROBLEMS ARE ALL SOLVABLE. THE PROGRAM WILL COMPUTE THE K-EFFECTIVE OF THE SYSTEM OR ALTERNATIVELY SEARCH FOR CRITICALITY BY MOVING SPATIAL BOUNDARIES, VARYING MATERIAL COMPOSITIONS, OR VARYING TRANSVERSE BUCKLING.
4. METHOD OF SOLUTION - THE EQUATIONS ARE SOLVED BY FINITE DIFFERENCE METHODS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA ARE -
 - 100 POINTS IN EACH DIRECTION
 - 100 POINTS IN CHANGE VECTOR
 - 100 ENERGY GROUPS
 - 1000 ISOTOPES
 - 1000 MATERIALS
 - 1000 ZONES
 - 1000 (POINTS) * (NUMBER OF SPECTRA IN LIBRARY DATA)
6. TYPICAL RUNNING TIME - 30 SECONDS PER 100 POINTS IN EACH ENERGY GROUP ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM - A GENERAL OUTPUT COMPILER IS PROVIDED WHICH CAN BE GIVEN OUTPUT INSTRUCTIONS IN ALGEBRAIC FORM AS PART OF THE PROBLEM INPUT DATA. THE USER CAN THEREBY DEVELOP HIS OWN ROUTINES FOR PROCESSING RESULTS. CROSS SECTIONS MAY BE PUT IN DIRECTLY OR MAY BE CHOSEN FROM THE PROGRAM LIBRARIES -- A GROUP CONDENSATION ROUTINE IS PROVIDED. THERE ARE FACILITIES FOR RUNNING PROBLEMS IN SUCCESSION -- PASSING FLUXES AND/OR DATA FROM PROBLEM TO PROBLEM. OPTIONAL MESH DOUBLING IS PROVIDED TO CHECK FINITE DIFFERENCE ERRORS OR TO SPEED UP CRITICALITY SEARCHES IN THE EARLY STAGES.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MARCH 1963, REVISED JUNE 1966.
10. REFERENCES - A. HASSITT, A COMPUTER PROGRAM TO SOLVE THE MULTIGROUP DIFFUSION EQUATIONS, TRG REPORT 229(R), MARCH 1962.
A. HASSITT, SUPPLEMENT TO TRG REPORT 229 (R), JANUARY 1963.
B. M. SEGAL, CRAM USERS GUIDE - REVISION NO. 1, P-63-201, MAY 15, 1963.

10. REFERENCES (CONTINUED)

B. M. SEGAL, INFORMATION FOR USERS OF APDA CRAM COMPILER OUTPUT ROUTINES, MAY 24, 1963.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN II MONITOR (7090).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - FILE 1 OF THE TAPE IS THE SOURCE DECK, BINARY DECK, AND SAMPLE PROBLEM FOR THE STANDARD LASL VERSION OF CRAM WHICH USES MAGNETIC TAPE FOR STORAGE. THE CROSS SECTION LIBRARIES, YOM, HANSEN, AND ANL-11, ARE CONTAINED IN CHAINS 1, 5, AND 6, RESPECTIVELY, OF BOTH THE SOURCE AND OBJECT DECKS. FILE 2 IS THE SOURCE DECKS FOR THOSE SUBROUTINES WHICH HAVE BEEN ALTERED BY LASL TO USE DISKS AND DRUMS RATHER THAN MAGNETIC TAPE FOR INTERMEDIATE STORAGE, THE OBJECT DECK FOR THE LASL DISK VERSION, AND A SAMPLE PROBLEM. FILE 3 IS HASSITT'S CPYCHN ROUTINE USED TO SUBSTITUTE ALTERNATE CHAINS (E.G., COMPILERS) WITHOUT HAVING TO START FROM A FULL BINARY OBJECT DECK. THE ID CARD, CONTROL CARDS, AND IOUS MAY REQUIRE CHANGING TO CONFORM TO THE SYSTEM BY WHICH THE CODE IS TO BE OPERATED. IOU IS AS FOLLOWS -

MONITOR	1	A1	
INPUT	2	A2	
OUTPUT	3	A3	
F.D. COEFFICIENTS	4	A4	SCRATCH
DUMP 1	9	A5	
SPARE COEFFICIENTS	12	A6	SCRATCH (LARGE PROBLEMS ONLY)
FLUX 1	5	B1	SCRATCH
FLUX 2	6	B2	SCRATCH
CHAINS	7	B3	
PUNCH	8	B4	
DUMP 2	10	B6	
	11	B5	NOT USED

15. NAME AND ESTABLISHMENT OF AUTHORS -

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REACTOR CODE ABSTRACT 103

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (22,270 CARDS)
SOURCE DECKS
BINARY DECKS
SAMPLE PROBLEMS
YOM, HANSEN, AND ANL-11 LIBRARIES
REFERENCE REPORT, SUPPLEMENT, AND MEMORANDA
17. CATEGORY - C
KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, SLABS, CYLINDERS,
SPHERES, 2-DIMENSIONAL, R-Z, X-Y, R-THETA, MULTIGROUP,
CRITICALITY SEARCHES, FLUX DISTRIBUTION, PROGRAMMING
LANGUAGES

1. NAME OR DESIGNATION OF PROGRAM - BAM
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - BAM COMPUTES THERMAL CONSTANTS, SPATIAL AND ENERGY DISTRIBUTIONS IN HETEROGENEOUS CYLINDRICAL CELLS BY ASSUMING SEPARABILITY OF SPACE AND ENERGY IN THE BOLTZMANN EQUATION.
4. METHOD OF SOLUTION - THE SPATIAL DISTRIBUTION IS FOUND USING THE S4 CYLINDRICAL GEOMETRY CODE AND THE SPECTRUM BY MEANS OF TEMPEST2. ALTHOUGH THIS METHOD IS NOT AS ACCURATE AS MORE SOPHISTICATED METHODS, THE METHOD IS COMMONLY USED AS AN ENGINEERING APPROXIMATION AND LEADS TO REASONABLY ACCURATE RESULTS IN SHORT TIMES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
CYLINDRICAL GEOMETRY
MAXIMUM NUMBER OF SPACE POINTS = 100
MAXIMUM NUMBER OF REGIONS = 10
6. TYPICAL RUNNING TIME - .5 TO 1.5 MINUTES ARE REQUIRED ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - S4 CYLINDRICAL GEOMETRY CELL CODE (ACC ABSTRACT 53) AND TEMPEST2 (ACC ABSTRACT 50)
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
10. REFERENCE - R. A. BLAINE, V. E. ANDERSON, AND B. F. MASKEWITZ, BAM - A CODE TO COMPUTE THERMAL GROUP CONSTANTS, AMTD-167, AUGUST 1962.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE TEMPEST2 CODE PACKAGE MATERIAL SHOULD BE REQUESTED TOGETHER WITH THE BAM MATERIAL.

REACTOR CODE ABSTRACT 108

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10/67

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE -

SOURCE DECK (958 CARDS)
SAMPLE PROBLEM (44 CARDS)
REFERENCE REPORT

17. CATEGORY - B

KEYWORDS - CELL CALCULATION, CYLINDERS, THERMAL SPECTRA, GROUP
CONSTANTS, SN METHOD

1. NAME OR DESIGNATION OF PROGRAM - 4RESTRAINT PIPE STRESS CODE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM EVALUATES A FOUR RESTRAINT PIPING SYSTEM DESIGNED FOR HIGH TEMPERATURE OPERATION.
4. METHOD OF SOLUTION - THE PROGRAM FINDS FORCES AND MOMENTS TO DETERMINE THE POINT OF MAXIMUM MOMENT AND THE RESULTING MAXIMUM STRESS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 1 MINUTE IS REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
10. REFERENCES - M. TARPINIAN, PIPE STRESS CODE IN STANDARD FORTRAN FIB II, AMTD-168, AUGUST 1962.
H. B. HOLTZ AND M. TARPINIAN, FOUR RESTRAINT PIPE STRESS CODE, NAA-TDR-93, JULY 1957.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3824 CARDS)
REFERENCE REPORTS
17. CATEGORY - I
KEYWORDS - PIPES, DESIGN, STRESSES, TEMPERATURE

REACTOR CODE ABSTRACT 110 1076701

1. NAME OR DESIGNATION OF PROGRAM - SCARF2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - SCARF2 EVALUATES THE FIRST-ORDER APPROXIMATION OF THE FAST NEUTRON CURRENT AT THE PAY LOAD SURFACE DUE TO NEUTRONS WHICH SCATTER FROM THE RADIATOR FINS. IT USES SNAP GEOMETRY AND IS A COMPLEMENTARY PROGRAM TO FARSE.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 1 TO 5 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - FARSE (ACC ABSTRACT 91) AND SCAR1 (ACC ABSTRACT 111)
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
10. REFERENCES - C. A. GOETZ AND M. A. BOLING, SCARF1, NAA-SR-TDR-5948, DECEMBER 1960.
C. A. GOETZ, SCAR1, NAA-SR-TDR-6191, MARCH 1961.
R. A. BLAINE, MODIFICATIONS TO SCAR1 AND SCARF1, DECEMBER 1962.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE -
SOURCE DECK (860 CARDS)
SUBROUTINE BESELF (1021 CARDS)
REFERENCE REPORTS

17. CATEGORY - J

KEYWORDS - FAST NEUTRONS, CURRENTS, SNAP REACTORS, SCATTERING,
SHIELDING, BESELF CODES

REACTOR CODE ABSTRACT 111 10/67

1. NAME OR DESIGNATION OF PROGRAM - SCAR1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - SCAR1 PERFORMS SINGLE SCATTER RAY TRACING AND EVALUATES SCATTERING FROM A RING. IT IS COMPLEMENTARY TO FARSE.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 1 TO 3 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - FARSE (ACC ABSTRACT 91) AND SCARF2 (ACC ABSTRACT 110)
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
10. REFERENCES - C. A. GOETZ, SCAR1, NAA-SR-TDR-6191, MARCH 1961.
C. A. GOETZ AND M. A. BOLING, SCARF1, NAA-SR-TDR-5948, DECEMBER 1960.
R. A. BLAINE, MODIFICATIONS TO SCAR1 AND SCARF1, DECEMBER 1962.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE -
SOURCE DECK (830 CARDS)
SUBROUTINE BESELF (1021 CARDS)
REFERENCE REPORTS

17. CATEGORY - J

KEYWORDS - SNAP REACTORS, SCATTERING, SHIELDING, ANNULAR SPACE,
BESELF CODES

REACTOR CODE ABSTRACT 112

10/67

1. NAME OR DESIGNATION OF PROGRAM - CROCK
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - CROCK SELECTS THE MINIMUM WEIGHT DESIGN FOR A SPACE POWER PLANT IN WHICH THE WASTE CYCLE HEAT IS RADIATED DIRECTLY TO SPACE FROM THE CONDENSER. IT ACCOUNTS FOR HEAT TRANSFER, FLUID FLOW, METEOROID PROTECTION, AND THE GEOMETRIC PROPERTIES OF A RADIATOR-CONDENSER.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 1 MINUTE IS REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED JUNE 1963.
10. REFERENCE - R. SHUDDE, H. L. FRIEDMAN, AND R. A. STONE, CROCK AND SHOCK - FORTRAN CODES FOR OPTIMIZATION OF HEAT-REJECTION SYSTEMS FOR SPACE POWER PLANTS, NAA-SR-6727, NOVEMBER 1961.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE -
SOURCE DECK (322 CARDS)
REFERENCE REPORT
17. CATEGORY - I
KEYWORDS - WEIGHT DESIGN, SPACE POWER PLANTS, HEAT TRANSFER,
FLUID FLOW

1. NAME OR DESIGNATION OF PROGRAM - ZOT
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - ZOT TAKES MULTIGROUP NEUTRON CROSS SECTION SETS IN THE SN FORMAT (SNG, DSN, ETC.) AND REDUCES THE NUMBER OF GROUPS (COLLAPSES) ACCORDING TO A GIVEN OR COMPUTED MULTIGROUP FLUX SPECTRUM. AVERAGE VELOCITIES FOR THE FEW-GROUP SET MAY BE GENERATED ON THE BASIS OF THE FLUXES AND VOLUMES FOR A GIVEN REACTOR CONFIGURATION.
4. METHOD OF SOLUTION - ACTIVITY, ABSORPTION, FISSION AND TRANSFER (BOTH UP AND DOWN SCATTERING) CROSS SECTIONS ARE COLLAPSED, AVERAGING ON THE BASIS OF THE FLUX SPECTRUM. THE TRANSPORT MEAN FREE PATH OR (OPTIONALLY) ITS INVERSE, THE TRANSPORT CROSS SECTION, IS COLLAPSED. FEW-GROUP INDIVIDUAL ELEMENT CROSS SECTIONS MAY BE PRODUCED OR MACROSCOPIC MIXTURE CROSS SECTIONS MAY BE FORMED AND COLLAPSED. IN THE LATTER CASE THE CODE CAN COMPUTE AN INFINITE MEDIUM FLUX SPECTRUM.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE FEW-GROUP ENERGY SPACING MUST BE A SUBSET OF THE MANY-GROUP SPACING. ONLY ISOTROPIC TRANSFER SCATTERING IS CONSIDERED. THE PROBLEM SIZE IS LIMITED ONLY BY FAST MEMORY CAPACITY. THE LARGEST BLOCK IS THE MANY-GROUP CROSS SECTION BLOCK, THE SIZE OF WHICH IS THE PRODUCT OF THE NUMBER OF CROSS SECTIONS PER GROUP TIMES THE NUMBER OF GROUPS TIMES THE SUM OF THE ELEMENTS AND MIXTURES.
6. TYPICAL RUNNING TIME - USUALLY INPUT-OUTPUT IS LIMITED TO 1 MINUTE PER CASE.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED FEBRUARY 1963.
10. REFERENCES - R. COOPER, A CODE FOR REDUCING MANY GROUP CROSS SECTIONS TO FEW GROUPS, LAMS-2801, NOVEMBER 1962.
B. G. CARLSON, C. S. KAZEK, JR., AND C. E. LEE, FLOCU II MANUAL, LAMS-2339, AUGUST 1959.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FLOCO2
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

REACTOR CODE ABSTRACT 113

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10/67

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE -

SOURCE DECK (80 CARDS)

SAMPLE PROBLEM (69 CARDS)

FLOCO2 DECK (134 CARDS)

REFERENCE REPORT, LAMS-2801

17. CATEGORY - B

KEYWORDS - MULTIGROUP AVERAGES, CROSS SECTIONS, INFINITE MEDIA
SPECTRA, ABSORPTION, FISSION, SCATTERING

1. NAME OR DESIGNATION OF PROGRAM - SHOCK
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - SHOCK SELECTS THE MINIMUM WEIGHT DESIGN FOR A HEAT-REJECTION SYSTEM FOR A SPACE POWER PLANT IN WHICH THE SENSIBLE HEAT LOST FROM A SINGLE-PHASE FLUID IS RADIATED TO SPACE. IT ACCOUNTS FOR HEAT TRANSFER, FLUID FLOW, METEOROID PROTECTION AND RADIATOR GEOMETRY.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 1 MINUTE IS REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED JUNE 1963.
10. REFERENCE - R. A. STONE, R. H. SHUDE, AND H. L. FRIEDMAN, CROCK AND SHOCK - FORTRAN CODES FOR OPTIMIZATION OF HEAT REJECTION SYSTEMS FOR SPACE POWER PLANTS, NAA-SR-6727, NOVEMBER 1961.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE -
SOURCE DECK (460 CARDS)
REFERENCE REPORT
17. CATEGORY - I
KEYWORDS - WEIGHT DESIGN, SPACE POWER PLANTS, HEAT TRANSFER,
FLUID FLOW

REACTOR CODE ABSTRACT 117

10/67

1. NAME OR DESIGNATION OF PROGRAM - FEVER
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - FEVER PERFORMS ONE-DIMENSIONAL FEW-GROUP DEPLETION CALCULATIONS. OPTIONS ARE AVAILABLE TO ADJUST CONTROL POISONS IN VARIOUS REGIONS OF THE REACTOR, SELF-SHIELDING OF LUMPED POISONS, AND TO CALCULATE HOT MAXIMUM AND COLD SHUT-DOWN MULTIPLICATION.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF MESH POINTS = 150
 - MAXIMUM NUMBER OF SPATIAL REGIONS = 20
 - MAXIMUM NUMBER OF NUCLIDES OR AGGREGATES IN EACH REGION = 25
 - MAXIMUM NUMBER OF GROUPS = 4
6. TYPICAL RUNNING TIME - PRODUCTION PROBLEMS HAVE BEEN RUNNING IN FROM 1 TO 30 MINUTES ON THE IBM7090 DEPENDING ON THE OPTIONS SELECTED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED JUNE 1963.
10. REFERENCE - F. TODT, FEVER - A ONE-DIMENSIONAL FEW-GROUP DEPLETION PROGRAM FOR REACTOR ANALYSIS, GA-2749, NOVEMBER 28, 1962, AND ERRATA MARCH 14, 1963.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN MONITOR SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - A ONE-DIMENSIONAL FEW-GROUP DIFFUSION CALCULATION IS USED TO DETERMINE THE FLUXES. DEPLETION IS CONSIDERED BY ZONE RATHER THAN BY MESH POINT. A LIBRARY OF FEW-GROUP MICROSCOPIC CROSS SECTIONS IS USED, AND IT IS ASSUMED THAT THE SHAPE OF THE FLUX SPECTRUM AND THE RELATIVE AMPLITUDE OF THE FLUX BETWEEN ZONES DOES NOT CHANGE OVER THE BURNUP TIME-STEP.

REACTOR CODE ABSTRACT 117

-2-

10/67

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECK (3893 CARDS)
BINARY DECK (593 CARDS)
REFERENCE REPORT AND ERRATA

17. CATEGORY - D

KEYWORDS - DEPLETION, DIFFUSION EQUATIONS, 1-DIMENSIONAL, FEW-
GROUP, CONTROL ROD SEARCHES

REACTOR CODE ABSTRACT 118

10/67

1. NAME OR DESIGNATION OF PROGRAM - ULCER
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - ULCER IS A MULTIGROUP, ONE-DIMENSIONAL DIFFUSION EQUATION CODE WITH UPSCATTER BASED ON FAIM (ACC ABSTRACT 120). ULCER DIFFERS FROM FAIM IN THAT -
 - (A) UPSCATTERING IS INCLUDED,
 - (B) DOWNSCATTER TO ALL LOWER GROUPS,
 - (C) MICROSCOPIC CROSS SECTIONS ARE ON TAPE,
 - (D) PROVISION FOR MULTIPLE FISSION SPECTRA,
 - (E) RESTART DUMP,
 - (F) FEW-GROUP REDUCTION, AND
 - (G) SPECTRUM COMPUTATION AND GRAPHICAL DISPLAY.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF ENERGY GROUPS = 40
 - MAXIMUM NUMBER OF SPACE POINTS = 101
 - MAXIMUM NUMBER OF REGIONS = 12
 - MAXIMUM NUMBER OF ELEMENTS IN EACH REGION = 20
 - MAXIMUM NUMBER OF GROUPS FOR DOWNSCATTER = 39
 - MAXIMUM NUMBER OF GROUPS FOR UPSCATTER = 32
6. TYPICAL RUNNING TIME - 2 TO 5 MINUTES ARE REQUIRED FOR 23-GROUP PROBLEMS ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
10. REFERENCE - D. S. VARGOFCAK, W. T. HAYES, AND D. W. ROEDER, ULCER, AMTD-123, APRIL 1962, ADDENDUM AMTD-123A, MARCH 1963, NAA-SR-MEMO-9891 PUBLICATION, MAY 1964.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (8874 CARDS)

SOURCE DECK
LIBRARY
ULCER CORRECTION DECK
REFERENCE REPORT

17. CATEGORY - C

KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, MULTIGROUP, SLABS,
CYLINDERS, SPHERES, CRITICALITY SEARCHES

REACTOR CODE ABSTRACT 119

10/67

1. NAME OR DESIGNATION OF PROGRAM - QUICKIE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - QUICKIE SOLVES THE NEUTRON SLOWING DOWN AND THERMALIZATION PROBLEM IN INFINITE MEDIA BY INVERTING A SET OF SIMULTANEOUS MULTIGROUP EQUATIONS. THE CODE USES THE ULCER (ACC ABSTRACT 118) LIBRARY TAPE AND IS IN EXCELLENT AGREEMENT WITH ULCER FOR THOSE CASES WHERE BUCKLING IS KNOWN.
4. METHOD OF SOLUTION - MATRIX INVERSION IS USED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF ENERGY GROUPS = 40
6. TYPICAL RUNNING TIME - 5 SECONDS ARE REQUIRED ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - ULCER (ACC ABSTRACT 118)
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
10. REFERENCES - W. A. RHOADES AND G. A. LONG, MULTIGROUP REACTIVITY CALCULATIONS FOR ONE-REGION SYSTEMS, NAA-SR-MEMO-7515, JUNE 1962.
M. BOLING AND W. RHOADES, QUICKIE - A COMPUTER PROGRAM FOR SPATIALLY INDEPENDENT MULTIGROUP SLOWING-DOWN AND THERMALIZATION CALCULATIONS, NAA-SR-9233, APRIL 15, 1964.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD IBM FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (2995 CARDS)
SOURCE DECK
LIBRARY
REFERENCE REPORTS

REACTOR CODE ABSTRACT 119

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10/67

17. CATEGORY - B

KEYWORDS - SLOWING DOWN, THERMALIZATION, INFINITE MEDIA, MULTI-
GROUP, REACTIVITY

REACTOR CODE ABSTRACT 120

10/67

1. NAME OR DESIGNATION OF PROGRAM - FAIM/FAIMOS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090,360, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - FAIM IS A MULTIGROUP, ONE-DIMENSIONAL DIFFUSION EQUATION PROGRAM BASED ON AIM6 (ACC ABSTRACT 29). THE PRINCIPAL FEATURES ARE -
 - (A) THREE GEOMETRIES,
 - (B) CALCULATION OF FLUXES AND MULTIPLICATION FACTOR,
 - (C) ONE-ITERATION PROBLEMS,
 - (D) CHOICE OF ONE OF FIVE SETS OF BOUNDARY CONDITIONS AT BOTH BOUNDARIES,
 - (E) CRITICALITY SEARCHES ON TRANSVERSE BUCKLING, HOMOGENEOUS POISON, CRITICAL RADIUS, ONE, TWO, OR THREE ELEMENT CONCENTRATION, LOCATION OF POISON REGION BOUNDARY, LOCATION OF A FUEL REGION BOUNDARY,
 - (F) ADJOINT FLUX CALCULATION, AND
 - (G) EXTENSIVE DATA EDIT.FAIMOS IS A MODIFIED VERSION OF FAIM. THREE GENERAL MODIFICATIONS WERE MADE -
 - (A) THE MICROSCOPIC CROSS SECTION LIBRARY AND ITS ASSOCIATED SUBROUTINES WERE REMOVED. AS A RESULT, OPTIONS REQUIRING THE USE OF MICROSCOPIC CROSS SECTIONS ARE NOT AVAILABLE.
 - (B) FAIM RAN AS A CHAIN JOB. OVERLAYS ARE NOT USED BY FAIMOS.
 - (C) THE PROGRAM LANGUAGE WAS CONVERTED FROM FORTRAN II TO FORTRAN IV(H). THIS MODIFICATION MADE NECESSARY A MINOR CHANGE IN THE DATA INPUT FORMAT.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF ENERGY GROUPS = 18
 - MAXIMUM NUMBER OF SPACE POINTS = 101
 - MAXIMUM NUMBER OF REGIONS = 20
 - MAXIMUM NUMBER OF GROUPS FOR DOWNSCATTER = 8
6. TYPICAL RUNNING TIME - .5 TO 2 MINUTES ARE REQUIRED ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - AIM6 (ACC ABSTRACT 29)
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
CDC1604 VERSION SUBMITTED JUNE 1966.
IBM360 VERSION SUBMITTED JUNE 1967.

10. REFERENCES - D. C. BALLER, THE FAIM CODE, A MULTIGROUP, ONE-DIMENSIONAL DIFFUSION EQUATION CODE, AMTD-118, JANUARY 1962, NAA-SR-7137 PUBLICATION, APRIL 15, 1962.
 D. C. BALLER, THE FAIM LIB CODE, AMTD-140, JULY 1962.
 D. C. BALLER, THE FAIM LIST CODE, AMTD-141, JULY 1962.
 R. G. COCKRELL, A DESCRIPTION OF FAIMOS, A MULTIGROUP ONE-DIMENSIONAL, NEUTRON DIFFUSION, EQUATION CODE, MAY 1967.
 H. P. FLATT, FINITE DIFFERENCE APPROXIMATIONS TO THE NEUTRON DIFFUSION EQUATION, AI-TDR-5889, 1960.
 R. G. COCKRELL, THE USE OF TEMPEST II, GAM-I, FAIM, AND PERT CODES FOR NEUTRONICS STUDIES OF NUCLEAR PROPULSION REACTORS, BOEING DOCUMENT NO. D5-13332, 1967.
 FAIM, NOTES CONCERNING THE CONTROL DATA VERSION.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP (7090), FORTRAN IV(H) (360), FORTRAN 63 (1604)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD FORTRAN II MONITOR (7090), OS/360 (360), AND COOP MONITOR (1604).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - SINCE THE FAIMOS CODE DOES NOT HAVE A MICROSCOPIC CROSS SECTION LIBRARY, THE USER MUST SUPPLY THE CROSS SECTION DATA. A DISCUSSION OF HOW SUCH DATA MAY BE COMPUTED IS GIVEN IN REFERENCE 6.
15. NAME AND ESTABLISHMENT OF AUTHORS -

7090	R. A. BLAINE SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT MATHEMATICS AND COMPUTER SCIENCES ATOMICS INTERNATIONAL P. O. BOX 309 CANOGA PARK, CALIFORNIA
1604	S. ELKIN NUCLEAR APPLICATIONS COMPUTATION CENTER CONTROL DATA CORPORATION COMPUTER DIVISION 3145 PORTER DRIVE P. O. BOX 10111 PALO ALTO, CALIFORNIA 94303
360	R. G. COCKRELL BOEING HUNTSVILLE SIMULATION CENTER THE BOEING COMPANY P. O. BOX 1680 HUNTSVILLE, ALABAMA 35807

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (FAIM 7090-3516 CARDS, 1604-4232 CARDS, FAIMLBGN
1604-108 CARDS, FAIMOS 360-3283 CARDS)
SAMPLE PROBLEMS (FAIM 1604-53 CARDS, FAIMOS 360-30 CARDS)
LIBRARIES (FAIM 7090-868 CARDS, FAIMLBGN 1604-909 CARDS)
INPUT SHEETS (4)
REFERENCE REPORTS, NAA-SR-7137, A DESCRIPTION OF FAIMOS (360),
AND NOTES (1604)
17. CATEGORY - C
KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, MULTIGROUP, SLABS,
CYLINDERS, SPHERES, CRITICALITY SEARCHES

1. NAME OR DESIGNATION OF PROGRAM - AIREK3
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090,360, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - AIREK3 FINDS THE NUMERICAL SOLUTION TO THE SPACE INDEPENDENT REACTOR KINETICS EQUATIONS BASED ON THE METHOD DEVELOPED BY E. R. COHEN. INPUT AND OUTPUT ARE SIMPLIFIED AND THE POWER, INVERSE PERIOD, FEEDBACKS, AND PRECURSORS ARE DISPLAYED GRAPHICALLY.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF PRECURSOR GROUPS = 15
MAXIMUM NUMBER OF FEEDBACKS = 50
6. TYPICAL RUNNING TIME - 1 MINUTE IS REQUIRED ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
CDC1604 VERSION SUBMITTED JUNE 1966.
IBM360 VERSION SUBMITTED APRIL 1967.
10. REFERENCE - L. R. BLUE AND M. HOFFMAN, GENERALIZED PROGRAM FOR THE NUMERICAL SOLUTION OF SPACE INDEPENDENT REACTOR KINETICS EQUATIONS, AMTD-131, JANUARY 1963.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM7090), FORTRAN IV (IBM360), FORTRAN 63 (CDC1604)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS360 (360).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
7090 R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANDGA PARK, CALIFORNIA

15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)

360 O. G. P. GROSSKOPF
SOUTH AFRICAN ATOMIC ENERGY BOARD
PRIVATE BAG 256
PELINDABA, PRETORIA, SOUTH AFRICA

1604 S. ELKIN
NUCLEAR APPLICATIONS COMPUTATION CENTER
CONTROL DATA CORPORATION
COMPUTER DIVISION
3145 PORTER DRIVE
P. O. BOX 10111
PALO ALTO, CALIFORNIA 94303

16. MATERIAL AVAILABLE -

SOURCE DECKS (7090-802 CARDS, 1604-519 CARDS, 360-388 CARDS)
SAMPLE PROBLEMS (1604-16 CARDS, 360-35 CARDS)
REFERENCE REPORT

17. CATEGORY - E

KEYWORDS - SPACE-INDEPENDENT KINETICS, COHEN EQUATION, FEEDBACK,
GRAPHS

1. NAME OR DESIGNATION OF PROGRAM - SNAPKIN5/SNAPKIN-5A
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - SNAPKIN5 PROVIDES A ONE-REGION TIME-DEPENDENT CALCULATION OF POWER, ENERGY, TEMPERATURE, REACTIVITY, INVERSE PERIOD, AND HYDROGEN LOSS IN A SNAP REACTOR AFTER A PERTURBATION FROM GIVEN INITIAL CONDITIONS. SNAPKIN-5A, IN ADDITION, WEIGHS POWER, HEAT CAPACITY, AND REACTIVITY IMPORTANCE FOR TWENTY-FIVE OR FEWER REGIONS.
4. METHOD OF SOLUTION - THE NUMERICAL METHOD IS THAT OF AIREK3 (ACC ABSTRACT 121).
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF REGIONS = 25
MAXIMUM NUMBER OF DELAYED NEUTRON GROUPS = 24
MAXIMUM NUMBER OF DIFFERENTIAL EQUATIONS = 50
6. TYPICAL RUNNING TIME - 1 MINUTE IS REQUIRED ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED MAY 1963.
10. REFERENCE - W. A. RHOADES AND G. A. LONG, SNAPKIN AND SNAPKIN A, NAA-SR-TDR-7517, JUNE 1962.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (7090-802 CARDS)
REFERENCE REPORT

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17. CATEGORY - E
KEYWORDS - SPACE-INDEPENDENT KINETICS, SNAP REACTORS, COHEN EQUATION, TEMPERATURE REACTIVITY

1. NAME OR DESIGNATION OF PROGRAM - LIPRECAN1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - LIPRECAN1 IS A TWO-DIMENSIONAL MONTE CARLO PROGRAM TO COMPUTE THE PENETRATION AND ENERGY DEPOSITION OF NEUTRONS IN PURE HYDROGENOUS MEDIA. THE CODE OFFERS THREE POSSIBLE GEOMETRIES, I. E., CONICAL, CYLINDRICAL AND ONE-DIMENSIONAL INFINITE SLAB GEOMETRY (THIS LATTER OPTION TO THE EXTENT THAT AN INFINITE SLAB MAY BE APPROXIMATED BY A CYLINDER OF LARGE RADIUS). THE CODE MAY BE USED WITH A MONO-DIRECTIONAL POINT OR BEAM SOURCE AND IS MODIFIED EASILY TO HANDLE ANGULAR DISTRIBUTIONS. ISOTROPIC SCATTERING IN THE CENTER OF MASS SYSTEM IS ASSUMED. THE FOLLOWING RESULTS ARE TABULATED WITH EACH SUMMARY -
 - (A) ENERGY DEPOSITION DISTRIBUTION,
 - (B) PARTICLE DEPOSITION DISTRIBUTION,
 - (C) PARTICLE LEAKAGE FRACTION,
 - (D) PARTICLE ABSORPTION FRACTION,
 - (E) THE FRACTION OF PARTICLES REACHING THE CUTOFF ENERGY WHICH HAVE NEITHER LEAKED NOR HAVE BEEN ABSORBED,
 - (F) THE AVERAGE ENERGY PER PARTICLE LEAKING FROM THE SYSTEM,
 - (G) THE AVERAGE ENERGY PER PARTICLE REMAINING IN THE SYSTEM AS HEAT GENERATION,
 - (H) THE AVERAGE NUMBER OF COLLISIONS PER HISTORY,
 - (I) THE TOTAL NUMBER OF HISTORIES CURRENTLY BEING SUMMARIZED,
 - (J) THE AVERAGE ENERGY DEPOSIT PER HISTORY THROUGH ABSORPTION,
 - (K) THE AVERAGE ENERGY OF PARTICLES ABSORBED.
4. METHOD OF SOLUTION - A MONTE CARLO SOLUTION IS USED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE CODE IS EQUIPPED WITH A 218-POINT HYDROGEN CROSS SECTION LIBRARY. AN INTERPOLATION ROUTINE IS USED TO DETERMINE THE CROSS SECTION FOR DISCRETE PARTICLE ENERGIES. AS MANY AS 200 ENERGY GROUPS MAY BE USED TO SPECIFY THE INCIDENT SPECTRUM. GEOMETRY-WISE, THE PROGRAM IS LIMITED TO THE SYSTEMS DESCRIBED UNDER ITEM 3. A GRID OF UP TO 50 BY 50 MAY BE SPECIFIED.
6. TYPICAL RUNNING TIME - THE RUNNING TIME IS A FUNCTION OF SEVERAL THINGS INCLUDING THE INCIDENT SPECTRA, THE CUTOFF ENERGY AND THE SYSTEM GEOMETRY. DEPENDING, THEREFORE, ON THE PROBLEM SPECIFICATION, RUNNING TIMES OF THE ORDER OF .1 TO .2 SECOND PER HISTORY MAY BE ANTICIPATED ON THE IBM7094 SYSTEM.
7. UNUSUAL FEATURES OF THE PROGRAM -
 - (A) AN EXCEPTIONALLY GOOD CROSS SECTION DESCRIPTION IN THE ENERGY RANGE FROM .1 EV TO 14.0 MEV.
 - (B) LEAKAGE BIASING AND ABSORPTION BIASING ARE PERFORMED WITH EACH COLLISION TO INCREASE THE VALIDITY OF RESULTS PERTAINING TO ALBEDO AND PARTICLE DEPOSITION.

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7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
(C) COMPLETE SUMMARIES ARE CALCULATED AND PRINTED AT SPECIFIED INTERVALS.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED FEBRUARY 1967.
10. REFERENCE - R. H. KARCHER, THE LIPRECAN I CODE - A MONTE CARLO PROGRAM FOR TWO-DIMENSIONAL NEUTRON PENETRATION AND ENERGY DEPOSITION IN LIQUID HYDROGEN, SM-43594, APRIL 1963.
11. MACHINE REQUIREMENTS - 32K WITH NUMBER OF TAPE UNITS PECULIAR TO THE FORTRAN II SYSTEM
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. H. KARCHER
MISSILES AND SPACE SYSTEMS DIVISION
DOUGLAS AIRCRAFT CORPORATION
SANTA MONICA, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (7090-599 CARDS)
BINARY DECK (7090-155 CARDS)
SAMPLE PROBLEM (7090-179 CARDS)
REFERENCE REPORT
17. CATEGORY - J
KEYWORDS - MONTE CARLO METHOD, 2-DIMENSIONAL, HYDROGEN, ISOTROPIC SCATTERING, SLABS, CYLINDERS, SHIELDING

1. NAME OR DESIGNATION OF PROGRAM - CONEC
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - CONEC IS A COUPLED NEUTRONIC-ELASTICITY CODE DESIGNED FOR APPLICATION TO PULSED FAST REACTOR SYSTEMS. IT IS A ONE-DIMENSIONAL CALCULATION, CAPABLE OF DEALING WITH SOLID SPHERES OR SPHERICAL SHELLS. SPECIFICALLY, CONEC CALCULATES THE ALPHA OF A SYSTEM, THE TEMPERATURE DISTRIBUTION, THE RADIAL AND TANGENTIAL STRESS DISTRIBUTIONS, AND FROM THESE THE ACCELERATIONS, VELOCITIES, AND DISPLACEMENTS THROUGHOUT THE SYSTEM.
4. METHOD OF SOLUTION - CONEC EMPLOYS THE MULTIGROUP S4 METHOD IN THE NEUTRONIC PART OF THE CALCULATION. THE ELASTICITY PART OF THE CALCULATION IS DESIGNED TO SOLVE THE EQUATION OF MOTION OF A SYSTEM SUBJECT TO AN ASSUMED THERMOELASTIC EQUATION OF STATE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE LARGEST POSSIBLE NUMBER OF MIXTURES THAT HAVE DISTINCT THERMAL AND ELASTIC CONSTANTS THAT CAN BE HANDLED IN THE PRESENT VERSION OF THE CODE IS SIX. ITS USE IS LIMITED TO SYSTEMS HAVING SPHERICAL SYMMETRY AND COMPOSED OF MATERIALS WHICH CAN BE DESCRIBED BY THERMOELASTIC EQUATIONS OF STATE. THE MAXIMUM TOTAL NUMBER OF ISOTOPES FOR WHICH CROSS SECTIONS ARE TO BE READ IN IS ALSO SIX.
6. TYPICAL RUNNING TIME - 10 TO 15 MINUTES ARE REQUIRED ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM - THIS PROGRAM IS MORE GENERAL THAN EITHER THE AX1 OR HATCHET PROGRAMS IN THAT SPHERICAL SHELLS OF ARBITRARY THICKNESS AS WELL AS THIN SHELLS AND SOLID SYSTEMS CAN BE HANDLED. ALSO CONSIDERABLE CRT (CATHODE RAY TUBE PICTORIAL DISPLAY) OUTPUT IS PROVIDED.
8. RELATED AND AUXILIARY PROGRAMS - AX1 (ACC ABSTRACT 102), HATCHET (ACC ABSTRACT 153)
9. STATUS - ABSTRACT FIRST DISTRIBUTED AUGUST 1963.
IBM7090 VERSION SUBMITTED JULY 1963.
10. REFERENCES - D. OKRENT ET AL., AX-1, A COMPUTING PROGRAM FOR COUPLED NEUTRONICS - HYDRODYNAMICS CALCULATIONS ON THE IBM 704 COMPUTER, ANL-5979, 1959.
D. C. KOLAR AND N. PRUVOST, CONEC - A COUPLED NEUTRONICS-ELASTICITY THEORY CODE AND ITS APPLICATION TO PULSED FAST REACTORS, UCRL-6798, 1962.
J. P. LEHMAN, HATCHET, A COUPLED NEUTRONIC-HYDRODYNAMIC CODE TO CALCULATE BURST CHARACTERISTICS OF A PULSED REACTOR FOR IBM 704, AN-237, 1960.
NOTE, DESCRIPTION OF IN-HOUSE SUBROUTINES.

11. MACHINE REQUIREMENTS - 32K MEMORY AND CRT OUTPUT HARDWARE IF CRT IS TO BE USED. NO CLOCK REQUIRED.
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN II MONITOR SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE INHOUSE LIVERMORE SUBROUTINES DEFINED IN REFERENCE 4 MUST BE REPLACED, OR FUNCTION DUPLICATED, OR REMOVED ENTIRELY. TAPE ASSIGNMENTS ARE AS FOLLOWS -
2A INPUT
3A OUTPUT
A SENSE SWITCH WILL TERMINATE THE JOB.
15. NAME AND ESTABLISHMENT OF AUTHORS -
O. C. KOLAR AND N. PRUVOST
LAWRENCE RADIATION LABORATORY
P. O. BOX 808
LIVERMORE, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (655 CARDS)
SAMPLE PROBLEM (58 CARDS)
REFERENCE REPORT, UCRL-6798, AND NOTE
17. CATEGORY - F
KEYWORDS - ELASTICITY, 1-DIMENSIONAL, SPHERES, SHELLS, SPACE-TIME DISTRIBUTION, TEMPERATURE, VELOCITY, STRESSES, SM METHOD, GRAPHS

1. NAME OR DESIGNATION OF PROGRAM - W-DSN
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - W-DSN SOLVES THE DISCRETE SN EQUATIONS IN CYLINDRICAL GEOMETRY. THE EIGENVALUE OPTION IS REACTIVITY (KEFF) ONLY. VOLUME DISTRIBUTED SOURCES ARE ALLOWED, BUT NO SURFACE SOURCES.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE SPLIT UP OF ENERGY GROUPS, SPATIAL MESH, AND SN ORDER IS FULLY VARIABLE, LIMITED ONLY BY THE TOTAL FAST STORAGE CAPACITY OF THE COMPUTER.
6. TYPICAL RUNNING TIME - 10 MINUTES ARE REQUIRED FOR A KEFF ITERATION EPSILON = 10^{-5} , A 30 SPACE-POINT MESH, 28 THERMAL GROUPS, 12 SLOWING-DOWN GROUPS, 10 POWER LOOPS COMPLETED, 3000 INNER ITERATIONS.
7. UNUSUAL FEATURES OF THE PROGRAM - THE CODE IS DESIGNED FOR THERMALIZATION PROBLEMS IN LATTICE CELL CONFIGURATIONS, AND THE GROUP ITERATION SCHEME IS DESIGNED TO CONVERGE QUICKLY IN THIS SITUATION. THE BOUNDARY CONDITION IS FREE OR GENERALIZED NON-LEAKAGE. THE DISCRETE ORDINATES MAY BE CHOSEN TO SATISFY LOW ORDER SPHERICAL HARMONICS CONDITIONS. THE OUTPUT IS DUMPED ON A TAPE WHICH MAY BE EDITED AT ANY TIME USING THE WED CODE.
8. RELATED AND AUXILIARY PROGRAMS - WED (ACC ABSTRACT 133)
9. STATUS - ABSTRACT FIRST DISTRIBUTED MARCH 1964.
IBM7090 VERSION SUBMITTED JUNE 1963.
10. REFERENCES - J. R. ASKEW AND R. J. BRISSENDEN, SOME IMPROVEMENTS IN THE DISCRETE ORDINATE METHOD OF B. CARLSON FOR SOLVING THE NEUTRON TRANSPORT EQUATION, AEEW-R-161, AUGUST 1963.
S. FRANCESCON, THE WINFRITH DSN PROGRAMME, AEEW-R-273, MAY 1963.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II, S1 (ALDERMASTON STRETCH COMPILER)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

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15. NAME AND ESTABLISHMENT OF AUTHORS -

J. ASKEW AND R. BRISSENDEN
A.E.E.
WINFRITH, ENGLAND

S. FRANCESCON
MATHEMATICS DEPARTMENT
UNIVERSITY COLLEGE
LEICESTER UNIVERSITY, ENGLAND

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2757 CARDS)
SAMPLE PROBLEM (52 CARDS)
REFERENCE REPORTS

17. CATEGORY - C

KEYWORDS - SN METHOD, 1-DIMENSIONAL, MULTIGROUP, CYLINDERS, REACTIVITY, FLUX DISTRIBUTION, CELL CALCULATION

1. NAME OR DESIGNATION OF PROGRAM - WED
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM EDITS THE MAGNETIC TAPE PRODUCED BY W-DSN CALCULATING REACTION RATES BY ENERGY AND BY VOLUME WITH TOTALS. IT CAN ALSO PRODUCE REACTION RATES FOR FED-IN CROSS SECTIONS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 3 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - W-DSN (ACC ABSTRACT 132)
9. STATUS - ABSTRACT FIRST DISTRIBUTED MARCH 1964.
IBM7090 VERSION SUBMITTED JUNE 1963.
10. REFERENCES - S. FRANCESCON, THE WINFRITH DSN PROGRAMME, AEEW-R-273, MAY 1963.
J. R. ASKEW AND R. J. BRISSENDEN, SOME IMPROVEMENTS IN THE DISCRETE ORDINATE METHOD OF B. G. CARLSON FOR SOLVING THE NEUTRON TRANSPORT EQUATION, AEEW-R-161, AUGUST 1963.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
J. ASKEW AND R. BRISSENDEN
A.E.E.
WINFRITH, ENGLAND

S. FRANCESCON
MATHEMATICS DEPARTMENT
UNIVERSITY COLLEGE
LEICESTER UNIVERSITY, ENGLAND
16. MATERIAL AVAILABLE -
SOURCE DECK (396 CARDS)
REFERENCE REPORTS

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17. CATEGORY - N

KEYWORDS - REACTION RATES, W-DSN CODES, OUTPUT DATA, DATA PRO-
CESSING

1. NAME OR DESIGNATION OF PROGRAM - NUCY
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604A
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE CALCULATION OF NUCLIDE CONCENTRATIONS AT A POINT IN A REACTOR AT SUCCESSIVE TIME INTERVALS, WITH EXPOSURE TO A TWO-GROUP NEUTRON FLUX. INFINITE SYSTEM CRITICALITY IS CALCULATED.
4. METHOD OF SOLUTION - AN EXPLICIT SOLUTION IS USED FOR FIXED FLUX-TIME INTERVALS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA ALLOWED ARE
MAXIMUM NUMBER OF DIFFERENT NUCLIDES = 99
MAXIMUM NUMBER OF NUCLIDE CHAINS = 50
MAXIMUM NUMBER OF NUCLIDES IN A CHAIN = 50
6. TYPICAL RUNNING TIME - A FEW SECONDS ARE REQUIRED FOR A CASE.
7. UNUSUAL FEATURES OF THE PROGRAM - THE PRIMARY EQUATIONS ARE USED IN A FORM THAT REDUCES LOSS OF SIGNIFICANCE IN SINGLE-PRECISION CALCULATIONS. A PROVISION IS INCORPORATED FOR CONSIDERING INTERLOCKING CHAINS. CIRCULATING AND NONCIRCULATING NUCLIDES MAY BE CONSIDERED IN THE SAME CALCULATION. CONCENTRATIONS OF SIX NUCLIDES MAY BE ADJUSTED TO MAINTAIN CRITICALITY. FLUX LEVELS MAY BE ADJUSTED TO MAINTAIN THE POWER LEVEL, AND THE RATIO OF FAST NEUTRON FLUX TO THERMAL-NEUTRON FLUX MAY BE ADJUSTED TO ACCOUNT FOR THE EFFECT OF A CHANGE IN THE THERMAL MACROSCOPIC ABSORPTION CROSS SECTION. ALL DATA ARE INPUT, SO PROGRAM CHANGES ARE NOT NECESSARY TO CONSIDER ANY SITUATION OF INTEREST. REACTION RATES AND SUMMED REACTIONS MAY BE OBTAINED WITH EACH NUCLIDE. RESONANCE INTEGRAL CORRELATIONS ARE USED.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED MARCH 1964.
IBM7090 VERSION SUBMITTED AUGUST 1963.
CDC1604A VERSION SUBMITTED AUGUST 1963.
10. REFERENCES - D. R. VONDY, DEVELOPMENT OF A GENERAL METHOD OF EXPLICIT SOLUTION TO THE NUCLIDE CHAIN EQUATIONS FOR DIGITAL MACHINE CALCULATIONS, ORNL-TM-361, OCTOBER 1962, AND ADDENDUM ORNL-TM-361A, 1963.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGES USED - FORTRAN II (7090) AND FORTRAN 63 (1604)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - NUCY WILL OPERATE UNDER ALMOST ANY SYSTEM.

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14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
D. R. VONDY
OAK RIDGE NATIONAL LABORATORY
P. O. BOX X
OAK RIDGE, TENNESSEE 37831
16. MATERIAL AVAILABLE -
SOURCE DECKS (7090-1023 CARDS, 1604-1023 CARDS)
BINARY DECKS (7090-164 CARDS, 1604-102 CARDS)
SAMPLE PROBLEMS (7090-63 CARDS, 1604-63 CARDS)
REFERENCE REPORTS
17. CATEGORY - D
KEYWORDS - CRITICALITY, REACTION RATES, DECAY, 2-GROUP FLUX DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - TRAFICORPORATION, COMPLEX TRANSFER FUNCTION SYNTHESIS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - EXPERIMENTAL FREQUENCY RESPONSE DATA OBTAINED FROM A LINEAR DYNAMIC SYSTEM IS PROCESSED TO OBTAIN THE TRANSFER FUNCTION AS A RATIO OF TWO FREQUENCY-DEPENDENT POLYNOMIALS. THE TRANSFER FUNCTION MAY HAVE NON-MINIMUM PHASE.
4. METHOD OF SOLUTION - THE POLYNOMIAL COEFFICIENTS ARE EVALUATED AS A RESULT OF MINIMIZING THE SUM OF THE SQUARES OF THE DIFFERENCES BETWEEN THE ABSOLUTE MAGNITUDE OF THE ACTUAL FUNCTION AND THE POLYNOMIAL RATIO.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
NUMERATOR POLYNOMIAL MUST BE OF SAME DEGREE OR ONE DEGREE LESS THAN DENOMINATOR.
NO POLES ARE PERMITTED AT THE ORIGIN.
MAXIMUM NUMBER OF EXPERIMENTAL POINTS = 250
MAXIMUM DEGREE OF THE POLYNOMIAL = 12
6. TYPICAL RUNNING TIME - 10 SECONDS PER PROBLEM ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED MARCH 1964.
IBM704 VERSION SUBMITTED SEPTEMBER 1963, DELETED OCTOBER 1967.
CDC3600 VERSION SUBMITTED DECEMBER 1964, SAMPLE PROBLEM EXECUTED BY ACC.
10. REFERENCES - E. C. LEVY, COMPLEX CURVE FITTING, IRE TRANSACTIONS ON AUTOMATIC CONTROL, AC-4, NO. 1, MAY 1959.
C. K. SANATHANAN AND J. KOERNER, TRANSFER FUNCTION SYNTHESIS AS A RATIO OF TWO COMPLEX POLYNOMIALS, ANL-6716, MAY 1963.
J. KOERNER AND C. K. SANATHANAN, TRAFICORPORATION, APPLIED MATHEMATICS DIVISION PROGRAM LIBRARY 1520/RE277, SEPTEMBER 27, 1962.
J. KOERNER AND C. K. SANATHANAN, THE RECENT MODIFICATIONS OF TRAFICORPORATION, R149.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - CDC3600 SCOPE.

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14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
JUDITH KOERNER AND C. K. SANATHANAN
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2122 CARDS)
BINARY DECK (711 CARDS)
SAMPLE PROBLEM (23 CARDS)
REFERENCE REPORTS, ANL-6716, AMDPL 1520/RE277, R149
17. CATEGORY - E
KEYWORDS - TRANSFER FUNCTIONS, FREQUENCY MEASUREMENTS

1. NAME OR DESIGNATION OF PROGRAM - HERESY1/KERNEL
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - HERESY1 CALCULATES THE REACTIVITY, THERMAL UTILIZATION, RESONANCE ESCAPE PROBABILITY, RELATIVE ROD ABSORPTIONS AND POWER DISTRIBUTION IN HETEROGENEOUS REACTORS HAVING TWO SPATIAL DIMENSIONS. HERESY1 CAN BE USED FOR NON-UNIFORM LATTICES, LATTICES WITH MANY TYPES OF FUEL AND CONTROL RODS, AND SPIKED AND SEEDED REACTORS. FISSIONS ARE ASSUMED TO OCCUR ONLY AT THERMAL ENERGY. RESONANCE ABSORPTIONS ARE LUMPED INTO ONE EQUIVALENT RESONANCE. THE MODERATOR IS ASSUMED TO BE INFINITE IN THE RADIAL DIRECTION, AND RODS ARE TREATED AS LINE SOURCES AND SINKS. THE ROD PARAMETERS ARE INDEPENDENT OF THE INTER-ROD SEPARATION DISTANCES. SLOWING-DOWN KERNEL FUNCTIONS MAY BE OF ANY TYPE - AGE THEORY, TRANSPORT THEORY, OR EMPIRICAL. A SELF-CONSISTENT PROCEDURE CAN BE USED WHICH EFFECTIVELY CANCELS OUT ANY ERRORS IN THE KERNEL FUNCTIONS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - UNIFORM LATTICES MAY BE INFINITE IN EXTENT. FOR NON-UNIFORM LATTICES NO MORE THAN 6500 RODS, 50 ROD TYPES AND 60 ENTRIES IN THE KERNEL FUNCTION TABLES ARE ALLOWED. THE MODERATOR ITSELF IS INFINITE IN EXTENT. ROD TYPES ARE DETERMINED BOTH ON THE BASIS OF ROD PARAMETERS AND GEOMETRICAL POSITION.
6. TYPICAL RUNNING TIME - ABOUT 36 SECONDS ARE REQUIRED FOR 50 ROD TYPES AND 1000 INDIVIDUAL RODS ON THE IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED MARCH 1964.
IBM7090 VERSION SUBMITTED DECEMBER 1963.
10. REFERENCES - C. N. KLAHR, L. B. MENDELSON, AND J. HEITNER, HETEROGENEOUS REACTOR CALCULATION METHODS, FINAL REPORT, NYO-2680, JUNE 30, 1961.
C. N. KLAHR, L. B. MENDELSON, AND J. HEITNER, HETEROGENEOUS REACTOR CALCULATION METHODS, QUARTERLY PROGRESS REPORT NO. 6, NYO-2678, SEPTEMBER 30, 1960.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -

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14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
THE 7090 VERSION OF HERESY1 REQUIRES ONE INPUT CHANGE -- ADD A
NEW CARD, PLACED SECOND IN THE INPUT DECK (AFTER THE TITLE CARD)
WHICH HAS THE NUMBER 1 IN COLUMN 5 FOR INFINITE LATTICE GEOME-
TRIES, OR NUMBER 2 IN COLUMN 5 FOR FINITE GEOMETRIES. KERNEL IS A
PROGRAM WHICH GIVES KERNELS TO HERESY BY WHOLE TABLES.
15. NAME AND ESTABLISHMENT OF AUTHORS -
C. N. KLAHR AND J. HEITNER
FUNDAMENTAL METHODS ASSOCIATES
31 UNION SQUARE WEST
NEW YORK, NEW YORK
16. MATERIAL AVAILABLE -
SOURCE DECKS (HERESY 858 CARDS, KERNEL 134 CARDS)
BINARY DECK (HERESY 191 CARDS)
SAMPLE PROBLEMS (HERESY 100 CARDS, KERNEL 7 CARDS)
REFERENCE REPORT, NYO-2680
17. CATEGORY - C
KEYWORDS - REACTIVITY, THERMAL UTILIZATION, RESONANCE ESCAPE
PROBABILITY, 2-DIMENSIONAL, POWER DISTRIBUTION, LAT-
TICES, THERMAL FISSION, HETEROGENEOUS REACTORS, KERNEL
CODES

1. NAME OR DESIGNATION OF PROGRAM - RATRAP
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE RATRAP PROGRAM COMPUTES THE DOSE RATE AT SPECIFIED SPATIAL POINTS ABOUT A SYSTEM OF SNAP GEOMETRY.
4. METHOD OF SOLUTION - AN ATTENUATION MODEL BASED ON MEAN FREE PATHS TRAVERSED ALONG A STRAIGHT LINE TRAJECTORY IS USED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF CORE-REFLECTOR SOURCE POINTS = 1000
MAXIMUM NUMBER OF DOSE POINTS = 50 (DIMENSIONS MAY BE ENTERED IN CENTIMETERS OR INCHES)
6. TYPICAL RUNNING TIME - ABOUT 100 POINTS PER SECOND CAN BE RUN ON THE IBM7094 WHERE NUMBER OF POINTS = (NUMBER OF SOURCE POINTS) * (NUMBER OF DOSE POINTS).
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - MORTIMER (ACC ABSTRACT 142)
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED FEBRUARY 1964.
10. REFERENCE - W. B. GREEN, THE RATRAP CODE - A MODIFICATION OF THE FARSE METHOD FOR SNAP SHIELD GEOMETRY, NAA-SR-MEMO-8968, SEPTEMBER 13, 1963.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
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ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (1322 CARDS)
SAMPLE PROBLEM (13 CARDS)
REFERENCE REPORT

REACTOR CODE ABSTRACT 141

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17. CATEGORY - J

KEYWORDS - DOSE RATES, SNAP REACTORS, SHIELDING

1. NAME OR DESIGNATION OF PROGRAM - MORTIMER
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - MORTIMER COMPUTES THE DOSE RATE AT SPECIFIED SPATIAL POINTS ABOUT A SYSTEM OF SNAP GEOMETRY.
4. METHOD OF SOLUTION - THREE TYPES OF DOSE RATE CALCULATIONS ARE AVAILABLE -
 - (A) DOSE RATE BASED ON AN ATTENUATION MODEL INCORPORATING MEAN FREE PATHS TRAVERSED ALONG A STRAIGHT LINE TRAJECTORY,
 - (B) ANGULARLY DEPENDENT LEAKAGE SURFACE DOSE RATE,
 - (C) A TWO-COMPONENT CALCULATION WITH BROAD BEAM CROSS SECTIONS, TO ACCOUNT FOR SCATTERED PARTICLE DOSE RATE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF CORE-REFLECTOR SOURCE POINTS = 1000
MAXIMUM NUMBER OF SHIELD MESH POINTS (FOR THE DIFFUSE DOSE CALCULATION) = 640
MAXIMUM NUMBER OF DOSE POINTS = 50
6. TYPICAL RUNNING TIME - ABOUT 100 POINTS PER SECOND CAN BE RUN ON THE IBM7094 WHERE NUMBER OF POINTS = (NUMBER OF SOURCE POINTS) * (NUMBER OF SHIELD MESH POINTS) * (NUMBER OF DOSE POINTS).
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - RATRAP (ACC ABSTRACT 141)
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED FEBRUARY 1964.
10. REFERENCE - W. B. GREEN, MORTIMER - A MODIFICATION OF THE RATRAP CODE WHICH INCLUDES THE TWO COMPONENT METHOD OF SHIELD ANALYSIS, NAA-SR-MEMO-9327, DECEMBER 16, 1963.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

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.0/67

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE -

SOURCE DECK (11209 CARDS)
REFERENCE REPORT

17. CATEGORY - J

KEYWORDS - DOSE RATES, SNAP REACTORS, SHIELDING

1. NAME OR DESIGNATION OF PROGRAM - MAC
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - MAC PERFORMS SLAB GEOMETRY, MULTIGROUP NEUTRON AND GAMMA RAY PENETRATION ANALYSIS FOR A MULTI-REGION REACTOR SHIELD. THE CODE CALCULATES THE FOLLOWING INFORMATION AS A FUNCTION OF DISTANCE THROUGH A REACTOR SHIELD ASSEMBLY -
NEUTRON FLUXES FOR UP TO 35 ENERGY GROUPS,
NEUTRON DOSE RATES,
THE APPROXIMATE NEUTRON SPECTRUM,
GAMMA RAY FLUXES FOR 7 ENERGY GROUPS,
TOTAL GAMMA DOSE RATE, WITH A BREAKDOWN OF THE CONTRIBUTION FROM SOURCES IN EACH REACTOR AND SHIELD REGION,
THE APPROXIMATE GAMMA RAY SPECTRUM.
4. METHOD OF SOLUTION - MAC IS WRITTEN TO CALCULATE MULTIGROUP NEUTRON FLUX BY A COMBINED REMOVAL THEORY AND A MULTIGROUP DIFFUSION ROUTINE WHERE THE FISSION NEUTRON SPECTRUM IS BROKEN INTO 18 ENERGY GROUPS AND THE SPATIAL DISTRIBUTION THROUGH THE SHIELD REGIONS OF THE FIRST NEUTRON COLLISION IS CALCULATED WITH A REMOVAL KERNEL AND ENERGY DEPENDENT COLLIMATED REMOVAL CROSS SECTIONS. FIRST COLLISION NEUTRONS ARE THEN PLACED IN A PROPER DIFFUSION ENERGY GROUP AND ISOTROPIC FLUX DISTRIBUTIONS AND NEUTRON CAPTURE DISTRIBUTIONS ARE CALCULATED. INELASTIC SCATTERING IS ACCOUNTED FOR WITH THE STATISTICAL EVAPORATION MODEL OF WEISSKOPF. MAC CALCULATES THE PRODUCTION OF GAMMA RADIATION IN THE REACTOR AND SHIELDS ARISING FROM THE FISSION PROCESS AND NEUTRON CAPTURE PROCESS. FOR CAPTURE GAMMA RAY PRODUCTION, THE CODE CALCULATES THE CAPTURE GAMMA RAY SOURCE AS A FUNCTION OF SPACE AND ENERGY DISTRIBUTION BY APPLYING THE NUMBER OF GAMMA RAYS PRODUCED IN EACH OF 7 GAMMA RAY ENERGY GROUPS FOR EACH NEUTRON CAPTURE IN EACH TYPE OF NUCLIDE. ALL GAMMA RAY SOURCES ARE THEN ATTENUATED THROUGH THE SHIELD LAYERS USING STANDARD ATTENUATION EQUATIONS WITH TAYLOR BUILDUP FACTORS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF SHIELD REGIONS = 20
MAXIMUM NUMBER OF NEUTRON ENERGY GROUPS = 35
MAXIMUM NUMBER OF ELEMENTS = 21
MAXIMUM NUMBER OF GAMMA RAY ENERGY GROUPS = 7
MAXIMUM NUMBER OF INELASTIC SCATTERING POSSIBILITIES FROM EACH OF THE TOP NEUTRON ENERGY GROUPS = 6
MAXIMUM NUMBER OF MESH POINTS = 2200
6. TYPICAL RUNNING TIME - AVERAGE PROBLEMS MAY BE SOLVED IN FROM 5 TO 20 MINUTES. SAMPLE PROBLEM EXECUTION REQUIRES 16 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - THE ENTIRE REACTOR SHIELD PROBLEM IS SOLVED IN ONE COMPUTER CALCULATION. TWO CROSS SECTION LIBRARIES ARE AVAILABLE CONTAINING COMPLETE CROSS SECTION AND GROUP

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7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
CONSTANT DATA FOR 77 ELEMENTS AND 7 ISOTOPES. THE ABSORPTION, ELASTIC SCATTERING, AND INELASTIC SCATTERING NEUTRON CROSS SECTIONS ARE GIVEN IN 15 AND 31 GROUP ENERGY-LETHARGY STRUCTURES. THE ADDITIONAL GROUP CONSTANTS ARE COMMON TO BOTH LIBRARIES AND INCLUDE - GAMMA RAY MASS ATTENUATION COEFFICIENTS (7 GROUP), ENERGY DEPENDENT REMOVAL CROSS SECTIONS (18 GROUP), NEUTRON AND GAMMA RAY FLUX TO DOSE CONVERSION FACTORS, TAYLOR BUILDUP FACTORS, AND THE GAMMA RAYS PRODUCED PER NEUTRON CAPTURE PER NUCLIDE.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED MARCH 1964.
10. REFERENCES - R. G. PETERSON, MAC - A BULK SHIELDING CODE, HW-73381, APRIL, 1962.
J. GREENBORG, TWO CROSS SECTION LIBRARIES FOR USE WITH MAC SHIELDING CODE, HW-73381, SUPPLEMENT, JANUARY, 1964.
J. GREENBORG, ADDITIONS AND ERRATUM TO HW-73381, SUPPLEMENT 1, NOVEMBER 13, 1964.
11. MACHINE REQUIREMENTS - 32K MEMORY AND 3 TAPE UNITS (INPUT, OUTPUT, AND SCRATCH)
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN II MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
CODE E. G. PETERSON
ABSTRACT J. GREENBORG
GENERAL ELECTRIC COMPANY
HANFORD LABORATORIES
RICHLAND, WASHINGTON

PRESENT CONTACT

D. R. MARR
BATTELLE-NORTHWEST
P. O. BOX 999
RICHLAND, WASHINGTON 99352

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECK (1167 CARDS)

BINARY DECK (291 CARDS)

SAMPLE PROBLEM (617 CARDS)

LIBRARIES (3214 CARDS)

REFERENCE REPORTS

17. CATEGORY - J

KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, MULTIGROUP, SLAPS,
GAMMA RADIATION, NEUTRONS, SPECTRA, SHIELDING, DOSE
RATES

REACTOR CODE ABSTRACT 144

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1. NAME OR DESIGNATION OF PROGRAM - DTF
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604A
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE DTF PROGRAM IS A ONE-DIMENSIONAL MULTIGROUP PROGRAM FOR SOLVING THE NEUTRON TRANSPORT EQUATION. THE PROGRAM CAN DETERMINE THE REGULAR OR ADJOINT SOLUTION FOR SLAB, CYLINDRICAL, OR SPHERICAL GEOMETRY. ISOTROPIC OR A FORM OF LINEAR ANISOTROPIC SCATTERING MAY BE CONSIDERED. VARIOUS BOUNDARY CONDITIONS ARE ALLOWED SO THAT CELLS OR TIME-DEPENDENT SOLUTIONS MAY BE OBTAINED USING FINITE AS WELL AS INFINITE CONFIGURATIONS IN THE CASE OF SLABS OR CYLINDERS. THE PROGRAM ALSO CONTAINS A NUMBER OF SEARCH OPTIONS WHEREBY ONE CAN VARY DIMENSIONS OR CONCENTRATIONS TO ARRIVE AT A PREDETERMINED EIGENVALUE. DISTRIBUTED OR SHELL SOURCES MAY BE SPECIFIED AT ANY POSITION WITHIN THE CONFIGURATION. AS OUTPUT THE PROGRAM SUPPLIES THE EIGENVALUE, ANGULAR FLUXES, TOTAL FLUXES, FISSION DISTRIBUTIONS, AND OTHER QUANTITIES. A LIBRARY OF CROSS SECTIONS IS AVAILABLE ON MAGNETIC TAPE. CROSS SECTIONS MAY BE READ FROM THIS LIBRARY TAPE AND/OR FROM CARDS.
4. METHOD OF SOLUTION - THE SN METHOD IS USED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF ENERGY GROUPS = 18
 - MAXIMUM NUMBER OF RADIAL INTERVALS = 75
 - MAXIMUM NUMBER OF ANGULAR DIRECTIONS = 24
 - MAXIMUM SN ORDERS FOR SPHERES AND SLABS = 23
 - MAXIMUM SN ORDERS FOR CYLINDERS = 8
 - MAXIMUM NUMBER OF NUCLIDES FROM TAPE = 25
 - MAXIMUM NUMBER OF MATERIALS, INCLUDING MIXES = 40
 - (TOTAL NUMBER OF CROSS SECTIONS (INCLUDING MIXES)) * (CROSS SECTION TABLE LENGTH) * (NUMBER OF ENERGY GROUPS) MUST BE LESS THAN OR = 4860
 - CROSS SECTION TABLE LENGTHS MUST BE LESS THAN OR = 9
6. TYPICAL RUNNING TIME - AN S8, 16 GROUP, K CALCULATION (CYLINDRICAL GEOMETRY) WITH A LOOP COUNT OF 2639 TOOK 4.8 MINUTES ON THE 3600 AND 14 MINUTES ON THE 1604.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
CDC1604A VERSION SUBMITTED MARCH 1964.
10. REFERENCES - B. G. CARLSON, W. J. WORTON, W. GUBER, AND M. SHAPIRO, DTF USERS MANUAL, UNC PHYS/MATH 3321, VOLUME 1, NOVEMBER 1963.

CONTENTS OF THE DTF SYSTEM TAPE, CO-OP NOTE.

10. REFERENCES (CONTINUED)

B. G. CARLSON, W. J. WORLTON, W. GUBER, AND
M. SHAPIRO, DTF USERS MANUAL, UNC PHYS/MATH 3321, VOLUME 2, MAY
1964.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGE USED - FORTRAN 63

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
COOP MONITOR.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

B. CARLSON AND W. WORLTON
LOS ALAMOS SCIENTIFIC LABORATORY
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO

W. GUBER AND M. SHAPIRO
UNITED NUCLEAR CORPORATION
WHITE PLAINS, NEW YORK

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3339 CARDS)
SAMPLE PROBLEMS (105 CARDS)
CROSS SECTION LIBRARY (3379 CARDS)
DTFDUP PROGRAM DECK (119 CARDS)
REFERENCE REPORTS AND NOTE

17. CATEGORY - C

KEYWORDS - SN METHOD, 1-DIMENSIONAL, MULTIGROUP, SLABS, CYLINDERS,
SPHERES, CRITICALITY SEARCHES, ANISOTROPIC SCATTERING

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1. NAME OR DESIGNATION OF PROGRAM - WEAK EXPLOSION PROGRAM
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM PERFORMS A COUPLED NEUTRONICS-HYDRODYNAMICS CALCULATION FOR A SPHERICALLY SYMMETRIC REACTOR CORE WITH A GIVEN COMPOSITION TO OBTAIN THE TIME-DEPENDENT ENERGY RELEASE THAT RESULTS FROM THE INSERTION OF REACTIVITY AT A GIVEN RATE. THE BASIC USE FOR THIS PROGRAM IS FOUND IN ANALYSIS OF FAST REACTOR CORE COLLAPSE ACCIDENTS.
4. METHOD OF SOLUTION - THE REACTOR CORE IS CONSIDERED TO BE DIVIDED INTO SPHERICAL SHELLS FIXED IN SPACE. THE NEUTRONICS ARE DETERMINED FROM POLYNOMIAL DISTRIBUTIONS OF POWER AND MATERIAL WORTH. THE KINETICS AND HYDRODYNAMIC EQUATIONS ARE COUPLED AND SOLVED BY THE MILNE METHOD AT SPECIFIED TIME INTERVALS. THE EQUATION OF STATE OF THE CORE MATERIAL IS IN THE EXPONENTIAL FORM AND THE DOPPLER EFFECT IS TAKEN INTO ACCOUNT BY THE USE OF A FLEXIBLE EXPRESSION INVOLVING BOTH THE $T(-3/2)$ LAW MODEL AND A THREE-TERM EXPONENTIAL MODEL. DELAYED NEUTRONS ARE TAKEN INTO ACCOUNT.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF DELAYED NEUTRON GROUPS = 10
MAXIMUM NUMBER OF SPHERICAL SHELLS = 200
6. TYPICAL RUNNING TIME - 1 MINUTE IS REQUIRED FOR A PROBLEM WITH 200 SPHERICAL SHELLS AND A TIME INTERVAL SPECIFIED SO THAT THE REACTIVITY CHANGE PER TIME INTERVAL IS ABOUT 0.3 CENTIMETER.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED MAY 1964.
10. REFERENCE - J. W. STEPHENSON, JR. AND R. B. NICHOLSON, WEAK EXPLOSION PROGRAM, ASTRA REPORT 417-6.0, FEBRUARY 28, 1961.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GENERAL MOTORS MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - NON-STANDARD INPUT-OUTPUT IS USED.

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15. NAME AND ESTABLISHMENT OF AUTHOR -
ALTON E. KLICKMAN
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1911 FIRST STREET
DETROIT, MICHIGAN
16. MATERIAL AVAILABLE -
SOURCE DECK (2591 CARDS)
SAMPLE PROBLEM (45 CARDS)
REFERENCE REPORT
17. CATEGORY - F
KEYWORDS - HYDRODYNAMICS, KINETICS, SPHERES, SHELLS, REACTIVITY,
FAST REACTORS

REACTOR CODE ABSTRACT 146

10/67

1. NAME OR DESIGNATION OF PROGRAM - NPRFCCP
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - NUCLEAR FUEL CYCLE COSTS IN DOLLARS PER YEAR (\$/YR), AND IN MILLS PER KILOWATT-HOUR (MILLS/KWHR) ARE COMPUTED AND TABULATED FOR EACH REGION OF A MULTIREGION REACTOR CORE, ON THE BASIS OF AEC-LEASED NUCLEAR FUEL MATERIAL AND OF PRIVATELY-OWNED NUCLEAR FUEL MATERIAL. FUEL CYCLE COSTS ARE COMPUTED SEPARATELY FOR EACH REGION OR ZONE, FOR CORE DESIGNS OF ANY CONFIGURATION OR COMBINATION OF MATERIAL DEPLETION OR ENRICHED URANIUM FUEL OR OTHER SPECIAL NUCLEAR MATERIAL. PRINTED OUTPUT OF THE PROGRAM INCLUDES (A) DETAILED FUEL CYCLE COSTS FOR EACH ZONE IN TABULAR FORM, FOR AEC-LEASED AND PRIVATELY-OWNED NUCLEAR FUEL MATERIAL, RESPECTIVELY, (B) A SUMMARY TABULATION OF NUCLEAR FUEL COSTS FOR ALL REGIONS OF THE COMPLETE CORE, INCLUDING FIXED CHARGES ON WORKING CAPITAL REQUIRED FOR CORE FABRICATION AND FOR NUCLEAR FUEL MATERIAL, (C) A SUMMARY TABULATION OF CERTAIN COMPUTED PERFORMANCE AND ECONOMIC DATA, VIZ., AVERAGE RESIDENCE TIME, ANNUAL FUEL THROUGHPUT, UNIT ELECTRICAL ENERGY YIELD, ANNUAL POWER GENERATION, AND CORE FABRICATION COSTS, AND (D) A TABULATION OF ALL INPUT DATA FOR ALL REGIONS. THE PRINTING OF DATA DESCRIBED IN (A) AND (D) ABOVE IS OPTIONAL WITH PROGRAM USE.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF REGIONS OR ZONES = 10
6. TYPICAL RUNNING TIME - 1 TO 2 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM - CERTAIN OF THE OPERATING AND ECONOMIC PARAMETERS WILL GENERALLY REMAIN CONSTANT FOR A WIDE RANGE OF REACTOR CORE DESIGNS. THEREFORE, THE PROGRAM INCLUDES A SET OF STANDARD VALUES FOR THESE PARAMETERS SO THAT THE AMOUNT OF BASIC INPUT DATA REQUIRED IS MINIMAL. THE USE OF THESE SO-CALLED STANDARD VALUES IS OPTIONAL WITH THE PROGRAM USER, AND ANY COMBINATION OF OR ALL OF THESE STANDARD VALUES MAY BE MODIFIED AS DESIRED. FUEL PROCESSING COSTS MAY BE COMPUTED FOR SPENT-FUEL MANAGEMENT PROGRAMS WHICH PROVIDE FOR THE REPROCESSING, SEPARATELY OR IN ANY COMBINATION, OF SINGLE OR MULTIPLE SPENT-FUEL BATCHES FROM ONE OR MORE REGIONS HAVING THE SAME OR DIFFERENT FINAL ENRICHMENTS. THUS, THE LOWEST COST SPENT-FUEL MANAGEMENT PROGRAM CAN BE READILY DETERMINED.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED JUNE 1964.

10. REFERENCE - J. T. JACKMAN, GUIDE TO NUCLEAR POWER COST EVALUATION, TID-7025, APRIL 30, 1963.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
J. T. JACKMAN
KAISER ENGINEERS
KAISER INDUSTRIES CORPORATION
KAISER CENTER
300 LAKESIDE DRIVE
OAKLAND, CALIFORNIA 94604
16. MATERIAL AVAILABLE -
SOURCE DECK (1512 CARDS)
BINARY DECK (367 CARDS)
SAMPLE PROBLEM (68 CARDS)
REFERENCE REPORT, APPENDIX A
17. CATEGORY - D
KEYWORDS - FUEL CYCLE ECONOMICS, PERFORMANCE

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1. NAME OR DESIGNATION OF PROGRAM - AILMOE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360,7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - AILMOE IS A MODIFIED FORM OF THE ANL ELMOE PROGRAM. THE FOURIER TRANSFORM OF THE FAST NEUTRON FLUX IS FOUND FOR A MIXTURE OF MODERATORS HEAVIER THAN HYDROGEN WITH THE MODERATOR SCATTERING LAW RIGOROUSLY ACCOUNTED FOR.
4. METHOD OF SOLUTION - A FINE GROUP STRUCTURE OF UP TO 750 GROUPS IS SUPERIMPOSED OVER THE COARSE, MULTIGROUP STRUCTURE AND A FUNDAMENTAL MODE CALCULATION IS PERFORMED IN EITHER THE P1, B1, CONSISTENT P1 OR CONSISTENT B1 OPTION. COARSE GROUP CROSS SECTIONS ARE PROVIDED BY THE USER. A LIBRARY OF LEGENDRE POLYNOMIAL EXPANSION COEFFICIENTS OF THE SCATTERING CROSS SECTION IS AVAILABLE FOR SEVERAL ELEMENTS FOR 1500 ENERGY GROUPS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF COARSE GROUPS = 24
MAXIMUM NUMBER OF ELEMENTS = 20
MAXIMUM NUMBER OF FINE GROUPS = 750
6. TYPICAL RUNNING TIME - 5 MINUTES ARE REQUIRED FOR THE FIRST PROBLEM AND 2 MINUTES FOR ADDITIONAL PROBLEMS ON THE IBM7094. 7 MINUTES ARE REQUIRED FOR THE FIRST PROBLEM AND 3 MINUTES FOR ADDITIONAL PROBLEMS ON THE IBM360/50 (ON-LINE MODE).
7. UNUSUAL FEATURES OF THE PROGRAM - THE BASIC MODIFICATIONS TO ELMOE CONSIST OF -
 - (A) MODIFYING THE TAPE MANIPULATION TO PERMIT UPDATING OR CREATING A LIBRARY TAPE IN THE SAME JOB AS AN ELMOE CALCULATION.
 - (B) MODIFYING THE COARSE GROUP LIBRARY ROUTINES.
 - (C) PROVIDING FOR INPUT OF MULTIGROUP BUCKLINGS AND SUPPRESSION OF THE BUCKLING ITERATION CALCULATION.
 - (D) PROVIDING RESTART CAPABILITY TO BYPASS RECALCULATION OF THE LIGHT ELEMENT SCATTERING MATRIX.
 - (E) PROVIDING FOR INPUT OF CHANGES TO THE COARSE GROUP CROSS SECTIONS WITHOUT REMAKING THE LIBRARY.
 - (F) PROVIDING PUNCHED OUTPUT OF ENERGY, FLUX SPECTRUM AND CURRENT SPECTRUM FOR USE WITH THE AI GRAVE (ACC ABSTRACT 162) AND GRISM CODES.
8. RELATED AND AUXILIARY PROGRAMS - A FORTRAN PROGRAM IS PROVIDED TO RECONSTRUCT THE BINARY LIBRARY TAPE FROM A TAPE CONTAINING 84 CHARACTER, BCD RECORDS OBTAINED FROM THE IBM704 BINARY TAPE PROVIDED BY ANL. THIS LIBRARY WILL CONTAIN ANL COARSE GROUP CROSS SECTION SET 199 (REFERENCE 3 BELOW).

9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM704 VERSION (ELMOE) SUBMITTED JUNE 1964 BY ANL,
DELETED OCTOBER 1967.
IBM360 VERSION SUBMITTED SEPTEMBER 1967.
IBM7094 VERSION SUBMITTED SEPTEMBER 1967.
10. REFERENCES - R. A. BLAINE, AILMOE, ATOMICS INTERNATIONALS VERSION
OF THE ELMOE CODE, NAA-SR-MEMO-11892, APRIL 1966.
R. A. BLAINE, AILMOE - CONVERSION TO SYSTEM/360, AI
COMPUTING NOTICE 18.W00009, DECEMBER 1966.
A. L. RAGO AND H. H. HUMMEL, ELMOE AN IBM 704 PROGRAM
TREATING ELASTIC SCATTERING RESONANCES IN FAST REACTORS, ANL-6805,
JANUARY 1964.
R. A. BLAINE, ATOMICS INTERNATIONAL ENVIRONMENT
REPORT, MAY 1967.
11. MACHINE REQUIREMENTS - 32K IBM7094, MINIMUM 256K BYTE IBM360
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP (7094) AND
FORTRAN IV (H) (360)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM FORTRAN MONITOR SYSTEM (7094) AND OS/360.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
NON-IBM USERS MUST PROVIDE THEIR OWN MEANS FOR READING PAST A TAPE
MARK. THIS FUNCTION IS PROVIDED BY THE FILE FUNCTION AT NAA. IBM
SYSTEM/360 USERS WILL NEED TO MODIFY THE DATA DEFINITION (DD)
CARDS TO CONFORM WITH THE STANDARDS OF THEIR INSTALLATIONS. THE
DISTRIBUTED PROCEDURE ASSUMES THAT AILMOE RESIDES IN THE LINK
LIBRARY WITH PROGRAM NAME W00009. THE DATA SET NAME FOR THE
COARSE GROUP LIBRARY IS W00009.ANLXEC AND FOR THE LEGENDRE COEF-
FICIENT LIBRARY - W00009.ANLLEG. THE REMAINDER OF THE DATA SETS
ARE EXPLAINED IN THE AI INSTALLATION ENVIRONMENT REPORT. THIS
PROCEDURE MUST RESIDE IN THE PROCLIB WITH MEMBER NAME W00009 TO
FUNCTION AS DESCRIBED IN THE SYSTEM/360 CONVERSION NOTICE. THE
SYSTEM/360 SOURCE DECK LIBRARY RECONSTRUCTION PROGRAM AND DD CARDS
ARE IN THE EBCDIC CHARACTER SET. THE FORTRAN II SOURCE DECK IS IN
THE BCD CHARACTER SET. THE DATA DECK IS ACCEPTABLE TO EITHER
CHARACTER SET. FORTRAN DATA SET REFERENCE NUMBER 14 IS USED FOR
THE PUNCHED OUTPUT.
15. NAME AND ESTABLISHMENT OF AUTHOR -
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SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
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P. O. BOX 309
CANOGA PARK, CALIFORNIA

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (2 TAPES)
SOURCE DECKS (AILMOE 7094-2021 CARDS, 360-2001 CARDS,
LIBRARY PROGRAM 360-91 CARDS)
SAMPLE PROBLEMS (AILMOE 7094-21 CARDS, 360-21 CARDS)
LIBRARY (FILE 1, TAPE 2 435 CARDS)
LEGENORE COEFFICIENTS (FILE 2, TAPE 2 12224 CARDS)
REFERENCE REPORTS
17. CATEGORY - 8
KEYWORDS - FOURIER TRANSFORM FAST FLUX, MODERATORS SCATTERING,
MULTIGROUP GROUP CONSTANTS, PL METHOD, BL METHOD

1. NAME OR DESIGNATION OF PROGRAM - TOPIC
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090,40
3. NATURE OF PHYSICAL PROBLEM SOLVED - TOPIC SOLVES THE ONE-DIMENSIONAL BOLTZMANN EQUATION IN CYLINDRICAL GEOMETRY WITH UP TO SIX ENERGY GROUPS, 240 SPACE POINTS, 40 REGIONS, AND ANISOTROPIC (P1) SCATTERING.
THE BOUNDARY CONDITIONS FOR EACH GROUP CAN BE INDEPENDENTLY SPECIFIED AND THE FLEXIBILITY OF THE SPECIFICATIONS PERMIT -
 (A) PERFECT MIRROR REFLECTION OR SYMMETRY,
 (B) ISOTROPIC REFLECTION (LAMBERT SURFACE REFLECTION), AND
 (C) ANISOTROPIC DIFFUSE SOURCES BY MEANS OF EITHER
 A P1 LEGENDRE SERIES OR A SHORT TABLE OF POINT VALUES FOR THE ANGULAR FLUX.
 INDEPENDENT SPECIFICATION OF ISOTROPIC FIXED VOLUME SOURCES FOR EACH GROUP IS ALSO ALLOWED.
 AS IMPLIED, BOTH HOMOGENEOUS AND INHOMOGENEOUS PROBLEMS ARE SOLVED, AND FISSIONS CAN OCCUR IN EITHER TYPE OF PROBLEM.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE TOPIC PROGRAM IS AVAILABLE IN FOUR SEPARATE CODES. THE RESPECTIVE LIMITS ON THE NUMBER OF MESH POINTS ON THE CYLINDER RADIUS ARE AS FOLLOWS -

CODE	ANGULAR INTERVALS ON AZIMUTHAL HALFSPACE	MESH POINTS	
		FORTRAN II	FORTRAN IV
TOPIC 4	4	240	185
TOPIC 6	6	140	108
TOPIC 8	8	90	70
TOPIC 10	10	62	48
6. TYPICAL RUNNING TIME - WITH 2 GROUPS, 40 SPACE POINTS, 4 INTERVALS ON THE AZIMUTHAL HALFSPACE, 2 GAUSS QUADRATURE POINTS ON THE POLAR ANGLE HALFSPACE, AND A POINTWISE GROUP FLUX CONVERGENCE CRITERION OF .0001, 2.17 MINUTES OF 7040 TIME WERE USED ON A TYPICAL FISSION EIGENVALUE PROBLEM WHICH CONVERGED IN 9 OUTER ITERATIONS (WITH NO INNER ITERATIONS).
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - TOPIC USES THE MIST (ACC ABSTRACT 59) SOLUTION METHOD TO SPEED THE CONVERGENCE OF THE MORE COMPLICATED CYLINDRICAL PROBLEM.
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED JULY 1964.
IBM7040 VERSION SUBMITTED JULY 1964.

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10. REFERENCE - G. E. PUTNAM, TOPIC - A FORTRAN PROGRAM FOR CALCULATING TRANSPORT OF PARTICLES IN CYLINDERS. IDO-16968, APRIL 1964.
11. MACHINE REQUIREMENTS - 32K WITH 9 TAPE UNITS
12. PROGRAMMING LANGUAGES USED - FORTRAN II (7090), FORTRAN IV (7040)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
GLEN E. PUTNAM
PHILLIPS PETROLEUM COMPANY
ATOMIC ENERGY DIVISION
IDAHO FALLS, IDAHO
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7040-3136 CARDS AND 7090-2890 CARDS)
SAMPLE PROBLEMS (7040-34 CARDS AND 7090-34 CARDS)
REFERENCE REPORT
17. CATEGORY - C
KEYWORDS - TRANSPORT THEORY, 1-DIMENSIONAL, FEW-GROUP, CYLINDERS,
ANISOTROPIC SCATTERING

1. NAME OR DESIGNATION OF PROGRAM - TYCHE3
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - TYCHE3 IS A MONTE CARLO CODE DESIGNED TO FIND THE SECOND, FOURTH AND SIXTH MOMENTS OF THE NEUTRON SLOWING DOWN DENSITY DISTRIBUTION IN AN INFINITE HOMOGENEOUS MEDIUM. NEUTRON WEIGHTS ARE USED TO AVOID THE TERMINATION OF A HISTORY BY ABSORPTION AND MINIMIZE THE RUNNING TIME. PROVISIONS ARE MADE FOR RESTART OF NON-CONVERGED PROBLEMS, GRAPHICAL DISPLAYS OF THE MOMENTS AND AVERAGE FISSION ENERGY AS A FUNCTION OF THE NUMBER OF SETS OF HISTORIES AND CALCULATION OF THE CORRECTION TO FLUX MOMENTS.
4. METHOD OF SOLUTION - USE IS MADE OF ANALYTIC TECHNIQUES TO SIMPLIFY THE DESCRIPTION OF THE NEUTRON HISTORY IN SPACE - CONSEQUENTLY, ONLY THE ANGLE OF SCATTERING AND THE ENERGY LOSS AT EACH COLLISION ARE NEEDED TO FIND THE MOMENTS. THE MOMENTS ARE FOUND BY USE OF RECURSION RELATIONS WHICH ALLOW THE HIGHER MOMENTS TO BE FOUND IN ESSENTIALLY THE SAME TIME AS THE SECOND.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF POINTS FOR THE ENERGY GRID * 1200
MAXIMUM NUMBER OF ELEMENTS * 5
MAXIMUM NUMBER OF SETS OF ANISOTROPIC SCATTERING COEFFICIENT SETS PER ELEMENT * 150
6. TYPICAL RUNNING TIME - 2000 HISTORIES PER MINUTE ARE RUN IN PREDOMINANTLY HYDROGENEOUS MEDIA AND ABOUT 350 IN CARBON ON AN IBM7094.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7094 VERSION SUBMITTED JULY 1964.
10. REFERENCES - R. A. BLAINE, TYCHE, A MONTE CARLO SLOWING DOWN CODE, NAA-SR-7357, JUNE 1962.
R. A. BLAINE, IMPROVEMENTS TO THE TYCHE MOMENTS CODE AND OPERATING INSTRUCTIONS FOR TYCHE III, NAA-SR-MEMO-9802, MAY 1964.
R. A. BLAINE, ISRCH, A BINARY SEARCH FORTRAN FUNCTION SUBPROGRAM, NAA-SR-MEMO-9721, APRIL 1964.
M. HOFFMAN AND W. A. RHOADES, AICRT 3 - A GENERAL CODE FOR THE DISPLAY OF DIGITAL DATA, NAA-SR-MEMO-9069, OCTOBER 1963.
11. MACHINE REQUIREMENTS -

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12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1716 CARDS)
SAMPLE PROBLEM (22 CARDS)
LIBRARY (122 CARDS)
REFERENCE REPORTS
17. CATEGORY - B
KEYWORDS - MONTE CARLO METHOD, SLOWING DOWN DISTRIBUTION, INFINITE MEDIA

1. NAME OR DESIGNATION OF PROGRAM - DANC OFF JR.
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS CODE EVALUATES MODERATOR SPACE CHORD DISTRIBUTION FUNCTIONS OF ZEROth AND FIRST ORDER, PLUS THEIR LINEAR, SQUARE, LOGARITHMIC AND EXPONENTIAL MOMENTS, FOR REGULAR AND IRREGULAR LATTICES OF CYLINDRICAL FUEL RODS CLAD WITH MATERIAL OF NEGLIGIBLE TOTAL CROSS SECTION. OF PARTICULAR SIGNIFICANCE FOR REACTOR DESIGN CALCULATIONS IS THE EXPONENTIAL MOMENT, OR DANC OFF CORRECTION, WHICH CAN BE CALCULATED EXACTLY IN INFINITE SQUARE AND HEXAGONAL LATTICES, IN CLUMPED SQUARE LATTICES WITH STRAIGHT OR CRUCIFORM WATER GAPS, OR IN CLUSTERS OF TWO, THREE, SEVEN, AND NINETEEN FUEL RODS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - FOR AN ACCURACY OF THREE SIGNIFICANT FIGURES, EACH PROBLEM REQUIRES 20 SECONDS PLUS 1 SECOND PER EVALUATED DANC OFF CORRECTION (WHICH IS A FUNCTION OF THE REMOVAL CROSS SECTION) PLUS 1 SECOND PER VALUE OF THE CHORD DISTRIBUTION FUNCTION (WHICH IS A FUNCTION OF CHORD LENGTH).
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED JULY 1964.
10. REFERENCE - H. GELLINGS AND A. SAUER, PROGRAMMBESCHREIBUNG ZU DANC OFF JR., ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT REPORT, KEA-114, 1963 (GERMAN).
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
A. SAUER
ALLGEMEINE ELEKTRICITATS
GESELLSCHAFT, E 3
6 FRANKFURT, GERMANY

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16. MATERIAL AVAILABLE -
SOURCE DECK (412 CARDS)
REFERENCE REPORT

17. CATEGORY - B
KEYWORDS - DANCORFF CORRECTION, LATTICES, FUEL ELEMENTS, CYLINDERS

1. NAME OR DESIGNATION OF PROGRAM - DTF2/ANISN
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090,360.
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE MULTIGROUP, ONE-SPACE DIMENSION NEUTRON TRANSPORT EQUATION IS SOLVED. ISOTROPIC OR LINEAR ANISOTROPIC SCATTERING IS PERMITTED BETWEEN ALL GROUPS AND A DIFFUSION SOLUTION MAY BE OBTAINED FOR ANY OR ALL GROUPS. HIGH-ORDER ANISOTROPIC SCATTERING PROBLEMS (PL) CAN BE RUN USING ANISN, THE 360 VERSION OF DTF2. WHITE/GREY BOUNDARY CONDITIONS ARE AVAILABLE, AND AN ALBEDO CAN BE SPECIFIED FOR EACH GROUP. A VOID STREAMING CORRECTION IS INCLUDED. A COMPLETE SHELL SOURCE DESCRIPTION BY GROUP, POSITION, AND ANGLE IS AVAILABLE. GRAPHICAL DISPLAY (CRT) FEATURES ARE AVAILABLE WITH ANISN.
4. METHOD OF SOLUTION - THE DISCRETE SN APPROXIMATION IS USED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - AS A RESULT OF THE VARIABLE ARRAY LENGTH METHOD EMPLOYED IN DTF2, THE ONLY RESTRICTION IMPOSED ON THE PROBLEM PARAMETERS IS THAT N, THE NUMBER OF CORE LOCATIONS RESERVED FOR DATA, IS NOT EXCEEDED. ON THE 7090,94 N IS APPROXIMATELY 18,000 DEPENDING ON THE MONITOR BEING USED. ON THE 360/MODEL 50 N IS APPROXIMATELY 30,000.
6. TYPICAL RUNNING TIME - RUNNING TIME IS PRIMARILY A FUNCTION OF THE NUMBER OF GROUPS, THE NUMBER OF SPACE POINTS, THE ORDER OF S(N) APPROXIMATION AND THE PRECISION DESIRED. ON THE 360 RUNNING TIME IS ALSO A FUNCTION OF THE ORDER OF THE ANISOTROPIC SCATTERING (PL) USED. THE TIME HAS VARIED FROM THIRTY SECONDS TO FOUR MINUTES ON THE 7090,94. PARAMETER SEARCHES REQUIRE SOMEWHAT LONGER TIMES.
7. UNUSUAL FEATURES OF THE PROGRAM - ALL FEATURES CONTAINED IN DTF HAVE BEEN RETAINED IN DTF II AND THE FOLLOWING FEATURES WERE ADDED -
 - (A) A METHOD OF VARIABLE ARRAY LENGTH HAS BEEN INCORPORATED IN DTF2 WHICH REMOVES THE USUAL FORTRAN DIMENSION RESTRICTIONS.
 - (B) CRITICALITY SEARCH ON TRANSVERSE BUCKLING.
 - (C) CONCENTRATION SEARCH WHICH ALLOWS SIMULTANEOUS INCREASE AND DECREASE IN THE CONCENTRATIONS OF TWO OR MORE ELEMENTS.
 - (D) CRT GRAPHICAL OUTPUT OF GROUP NEUTRON FLUX AND FISSION DENSITY VERSUS RADIUS, NEUTRON SPECTRA VERSUS EITHER LETHARGY OR ENERGY FOR SELECTED RADII, AND GROUP IMPORTANCE FUNCTIONS VERSUS RADIUS IF BOTH AN ADJOINT AND REGULAR SOLUTION ARE OBTAINED.
 - (E) LINEAR FLUX WEIGHTED FEW-GROUP CONSTANTS MAY BE OBTAINED FROM THE MULTIGROUP SOLUTION. THE FEW-GROUP CALCULATION INCLUDES CRT GRAPHICAL OUTPUT OF THE FEW-GROUP NEUTRON FLUX AND THE FEW-GROUP

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)

ABSORPTION AND TRANSPORT CROSS SECTIONS VERSUS
RADIUS.

ALL FEATURES CONTAINED IN DTF2 HAVE BEEN RETAINED IN ANISN/DTF2
AND THE FOLLOWING FEATURES WERE ADDED -

- (A) HIGH-ORDER ANISOTROPIC SCATTERING PROBLEMS CAN BE RUN.
- (B) PROBLEMS REQUIRING MORE STORAGE THAN IS AVAILABLE IN CORE
CAN BE RUN USING TWO LEVELS OF SUPPLEMENTAL TAPE STORAGE.
- (C) ALL INPUT DATA ARE RETAINED BETWEEN PROBLEMS IN MOST
CASES.
- (D) WHITE/GREY BOUNDARY CONDITIONS ARE AVAILABLE, AND AN
ALBEDO CAN BE SPECIFIED FOR EACH GROUP.
- (E) A VOID STREAMING CORRECTION IS INCLUDED.
- (F) A COMPLETE SHELL SOURCE DESCRIPTION, BY GROUP, POSITION,
AND ANGLE IS AVAILABLE.

8. RELATED AND AUXILIARY PROGRAMS - DTF (ACC ABSTRACT 144). AN
AUXILIARY LIBRARY PREPARATION PROGRAM IS INCLUDED WITH BOTH DTF2
AND ANISN. IN ANISN THIS PROGRAM IS CALLED ALP.9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED MAY 1966.
IBM360 VERSION SUBMITTED MAY 1967.10. REFERENCES - W. W. ENGLE, M. A. BOLING, AND B. W. COLSTON, DTF-II,
A ONE-DIMENSIONAL, MULTIGROUP NEUTRON TRANSPORT PROGRAM,
NAA-SR-10951, MARCH 15, 1961.

NOTE ON DTF II PROGRAM TAPE PREPARATION.

W. W. ENGLE, JR., A USERS MANUAL FOR ANISN, A ONE-
DIMENSIONAL DISCRETE ORDINATES TRANSPORT CODE WITH ANISOTROPIC
SCATTERING, K-1693, MARCH 30, 1967.

M. A. BOLING AND W. A. RHOADES, ANISN/DTF II, CON-
VERSION TO IBM SYSTEM/360, AI-66-MEMO-171, VOL. I, APRIL 1967.

M. A. BOLING, ALP-ANISN LIBRARY PROGRAM, NAA-SR-
12203, OCTOBER 18, 1966.

R. D. DOCTOR AND M. A. BOLING, A 23 GROUP NEUTRON
THERMALIZATION CROSS SECTION LIBRARY, NAA-SR-8742, JULY 15, 1963.

R. A. BLAINE, ATOMICS INTERNATIONAL ENVIRONMENT
REPORT, MAY 1967.

11. MACHINE REQUIREMENTS - 32K MEMORY (7090,94) AND 256K BYTES (360)

12. PROGRAMMING LANGUAGES USED - FORTRAN II (7090,94) AND FORTRAN IV
(H) (360)13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD FORTRAN MONITOR SYSTEM (7090) AND OS360 (360).14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
SEVERAL CRT CONVERSION AND PLOTTING ROUTINES ARE NOT INCLUDED.
THESE ARE AICRT3, BNBCDV, AND SPRNTV.

15. NAME AND ESTABLISHMENT OF AUTHORS -

DTF2

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ANISN

M. A. BOLING
MATHEMATICS AND COMPUTING SCIENCES
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECKS (DTF2 4567 CARDS, DTF2 LIBRARY PROGRAM 151 CARDS,
ALP 246 CARDS, ANISN 3689 CARDS)
OBJECT DECKS (ALP 174 CARDS, ANISN 3687 CARDS)
SAMPLE PROBLEMS (DTF2 444 CARDS, ANISN 382 CARDS)
LIBRARIES (DTF2 4630 CARDS, ANISN 2313 CARDS)
REFERENCE REPORTS AND NOTE

17. CATEGORY - C

KEYWORDS - TRANSPORT THEORY, 1-DIMENSIONAL, MULTIGROUP, ANISOTRO-
PIC SCATTERING, SLABS, CYLINDERS, SPHERES, ALP CODES

1. NAME OR DESIGNATION OF PROGRAM - ARGUS (RE248)
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM CALCULATES TRANSIENT TEMPERATURES IN A CONCENTRIC, CYLINDRICAL CONFIGURATION. UP TO 25 CONCENTRIC REGIONS ARE ALLOWED, EACH CONTAINING EITHER A STATIONARY (SOLID OR NON-FLOWING LIQUID) OR TURBULENTLY FLOWING (LIQUID OR GAS) MATERIAL. ANY STATIONARY REGION CAN HAVE SPATIAL- AND TIME-DEPENDENT HEAT GENERATION. TEMPERATURES ARE CALCULATED AT NODE POINTS EQUALLY-SPACED WITHIN A REGION. FILM COEFFICIENTS ON FLOWING REGION BOUNDARIES ARE CALCULATED BY THE PROGRAM. TIME-DEPENDENT COOLANT VELOCITIES ARE PERMITTED. THE HEAT SOURCE IS ASSUMED TO BE ANGULAR INDEPENDENT. AXIAL HEAT CONDUCTION IS NEGLECTED, BUT AXIAL HEAT TRANSPORT DUE TO MATERIAL MOTION IS CONSIDERED IN THE FLOWING REGIONS.
4. METHOD OF SOLUTION - TEMPERATURES ARE CALCULATED AT EACH NODE POINT AT DISCRETE TIME INTERVALS USING FINITE DIFFERENCE METHODS. SECOND ORDER POLYNOMIALS ARE USED TO APPROXIMATE THE TEMPERATURE DEPENDENCE OF THE PROPERTIES OF THE FLOWING MATERIALS. THE THERMAL PROPERTIES OF STATIONARY MATERIALS ARE CONSIDERED CONSTANT WITHIN A TEMPERATURE PHASE. THERE MAY BE UP TO 9 PHASE CHANGES, WITH HEATS OF TRANSFORMATION ADDED TO THE MATERIAL AT THE TRANSFORMATION TEMPERATURES. THERMAL RESISTANCES AT STATIONARY REGION INTERFACES ARE CONSIDERED BY MEANS OF INPUT COEFFICIENTS OF HEAT TRANSFER.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF NODE POINTS = 1600 (100 IN THE RADIAL DIRECTION AND 16 IN THE AXIAL DIRECTION)
 - MAXIMUM NUMBER OF REGIONS (INCLUDING A MAXIMUM OF 10 FLOWING REGIONS) = 25
 - MAXIMUM NUMBER OF MATERIALS = 10
 - MAXIMUM NUMBER OF TEMPERATURE PHASES = 10
 - MAXIMUM NUMBER OF TIME-DEPENDENT VELOCITY FUNCTIONS OF 250 POINTS EACH = 4
 - 1 TIME-DEPENDENT HEAT GENERATION FUNCTION OF 500 POINTS
6. TYPICAL RUNNING TIME - RUNNING TIME (IN MINUTES) = $.125 * (\text{NO. OF NODE POINTS}) * (\text{CUT OFF TIME}/6000) * (\text{TIME INCREMENT})$.
7. UNUSUAL FEATURES OF THE PROGRAM - ESSENTIALLY COMPLETE FLEXIBILITY IN THE SHAPE OF THE HEAT GENERATION FUNCTION IS PROVIDED THROUGH POINTWISE SPECIFICATION OF ITS SPATIAL- TIME-DEPENDENT COMPONENTS. THE TIME DEPENDENCE OF THE FLOWING MATERIAL VELOCITIES IS SPECIFIED POINTWISE, ALSO. SIMILARLY, THE EQUATIONS FOR CALCULATING THE FILM COEFFICIENTS ON FLOWING MATERIAL BOUNDARIES WERE CHOSEN TO ACCOMMODATE A WIDE VARIETY OF NEEDS. COOLING, AS WELL AS HEATING, OF STATIONARY MATERIALS THROUGH PHASE TRANSFORMATIONS IS ALLOWED. ONCE THE TEMPERATURE

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
OF A FLOWING MATERIAL REACHES THE SATURATION POINT, HOWEVER,
IT IS HELD THERE, AND NO COOLING IS ALLOWED.
8. RELATED AND AUXILIARY PROGRAMS - THIS PROGRAM SUPERCEDES THE
MORE RESTRICTED CYCLOPS (RE147).
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
CDC3600 VERSION SUBMITTED AUGUST 1964, SAMPLE PROBLEM
EXECUTED BY ACC.
10. REFERENCES - D. F. SCHOEBERLE, J. HEESTAND, AND L. B. MILLER,
AXISYMMETRIC, CYLINDRICAL CONFIGURATION, THE ARGUS PROGRAM,
1089/RE248, WRITTEN IN FORTRAN II, ANL-6654, NOVEMBER 1963, AND
ERRATA.
J. HEESTAND, D. F. SCHOEBERLE, AND L. B. MILLER,
THE CALCULATION OF TRANSIENT TEMPERATURE DISTRIBUTIONS IN A SOLID
CYLINDRICAL PIN, COOLED ON THE SURFACE, IBM704 PROGRAM 524/RE147,
ANL-6297, OCTOBER 1960.
11. MACHINE REQUIREMENTS - CDC3600 MINIMUM SCOPE CONFIGURATION AND
64K MEMORY.
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
SCOPE.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
THE CDC3600 SOURCE VERSION OF THIS CODE SHOULD BE COMPATIBLE WITH
OTHER MACHINES, SUBJECT TO MONITOR RESTRICTIONS, OF COURSE, EXCEPT
THAT THE COMMON AND EQUIVALENCE STATEMENTS SHOULD BE CHECKED TO
INSURE THAT THE VARIABLE Y (=TDT) PRECEDES ALL OTHERS IN COMMON
STORAGE ASSIGNMENT.
15. NAME AND ESTABLISHMENT OF AUTHOR -
J. HEESTAND
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2187 CARDS)
BINARY DECK (840 CARDS)
SAMPLE PROBLEMS (123 CARDS)
REFERENCE REPORTS.
17. CATEGORY - H
KEYWORDS - SPACE-TIME HEATING, TEMPERATURE DISTRIBUTION, CYLIN-
DERS, HEAT TRANSFER, VELOCITY, RE248 CODES

REACTOR CODE ABSTRACT 153

10/67.

1. NAME OR DESIGNATION OF PROGRAM - HATCHET
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - HATCHET IS A MAJOR MODIFICATION OF THE AX1 CODE DESIGNED TO STUDY BURST CHARACTERISTICS OF A SUPERPROMPT CRITICAL, CONCENTRIC SHELL, PULSED REACTOR. IT COMPUTES SPECIFIC ENERGY, TEMPERATURE, PRESSURE, DENSITY AND VELOCITY VARIATIONS AS A FUNCTION OF TIME AND SPACE. THE CODE ALSO COMPUTES REACTIVITY AS A FUNCTION OF INVERSE REACTOR PERIOD, POWER, THE TOTAL AND KINETIC ENERGIES, AND THE POSITION OF THE SHELLS WHICH COMPRISE THE SYSTEM.
4. METHOD OF SOLUTION - HATCHET RETAINS THE S4 NEUTRONICS CALCULATION OF AX BUT THE HYDRODYNAMICS SECTION HAS BEEN GREATLY MODIFIED TO CONFORM TO THE CONCENTRIC SHELL DESIGN. USE OF THIN SHELL THEORY DICTATES THAT INTERNAL PROPERTIES, SUCH AS STRESS, DENSITY, AND TEMPERATURE, CANNOT VARY RADIALY IN A GIVEN SHELL, ONLY FROM SHELL TO SHELL.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF ENERGY GROUPS = 3
MAXIMUM NUMBER OF MATERIALS = 6
6. TYPICAL RUNNING TIME - TYPICAL TIME FOR A PULSE IS 40 MINUTES PER ENERGY GROUP.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - AX1 (ACC ABSTRACT 102)
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED AUGUST 1964.
10. REFERENCES - J. P. LEHMAN, HATCHET, A COUPLED NEUTRONICS - HYDRODYNAMICS CODE TO CALCULATE BURST CHARACTERISTICS OF A PULSED REACTOR FOR IBM704, AN-237, SEPTEMBER 15, 1960.
P. J. DUBOIS, MODIFICATION OF THE HATCHET CODE FOR 7090 OPERATION, MATHEMATICS DEPARTMENT MEMORANDUM, FEBRUARY 14, 1962.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM FORTRAN II MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - DELAYED NEUTRON EFFECTS ARE IGNORED AND NO ALLOWANCE IS MADE FOR TRANSFER OF HEAT.

REACTOR CODE ABSTRACT 153

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15. NAME AND ESTABLISHMENT OF AUTHOR -

J. P. LEHMAN
AEROJET-GENERAL NUCLEONICS
P. O. BOX 77
SAN RAMON, CALIFORNIA

16. MATERIAL AVAILABLE -

SOURCE DECK (753 CARDS)
BINARY DECK (196 CARDS)
REFERENCE REPORT AND MEMORANDUM

17. CATEGORY - F

KEYWORDS - HYDRODYNAMICS, SPACE-TIME DISTRIBUTION, TEMPERATURE,
PRESSURE, VELOCITY, 1-DIMENSIONAL, SHELLS, SN METHOD,
REACTIVITY

REACTOR CODE ABSTRACT 154

10/67

1. NAME OR DESIGNATION OF PROGRAM - CROC90
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE CROC90 CODE WAS DEVELOPED FOR USE IN THE DATA REDUCTION OF OUT-OF-PILE FLUID FLOW EXPERIMENTS ON THE ML-1 FUEL ELEMENTS. THE CODE IS SPECIFICALLY DESIGNED TO EVALUATE FRICTION FACTORS, ENTRANCE AND EXIT COEFFICIENTS, AND ORIFICE CALIBRATIONS FROM HYDRODYNAMIC DATA OBTAINED FROM SINGLE PHASE EXPERIMENTAL FLUID FLOW TESTS IN AXIAL FLOW DUCTS.
4. METHOD OF SOLUTION - THE HYDRODYNAMIC CHARACTERISTICS OF A PASSAGE THROUGH WHICH FLUID FLOWS CAN BE OBTAINED EXPERIMENTALLY BY MEASURING THE FLOW RATE, THE PRESSURE DROP IN THE PASSAGE, GEOMETRICAL CONSTANTS, AND FLUID PROPERTIES. THE CODE IS WRITTEN FOR A TEST LOOP WITH AN INDEPENDENT ORIFICE FLOW METER.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - AS PRESENTLY COMPILED THIS CODE IS LIMITED FOR USAGE ONLY IN CONJUNCTION WITH THE TEST SECTION IN THE AGN OUT-OF-PILE WATER LOOP.
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7090 VERSION SUBMITTED AUGUST 1964.
10. REFERENCE - N. KATTCHIEE, MEMORANDUM CROC-90 - A FLUID FLOW DATA REDUCTION CODE FOR THE IBM7090 COMPUTER, AN-AGCR-383, NOVEMBER 26, 1962.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
N. KATTCHIEE
AEROJET-GENERAL NUCLEONICS
P. O. BOX 77
SAN RAMON, CALIFORNIA

REACTOR CODE ABSTRACT 154

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10/67

16. MATERIAL AVAILABLE -

SOURCE DECK (134 CARDS)

SAMPLE PROBLEM (36 CARDS)

REFERENCE REPORT

17. CATEGORY - 0

KEYWORDS - ML-1 REACTORS, FUEL ELEMENTS, HYDRODYNAMICS, FLUID
FLOW, MEASUREMENTS, DATA PROCESSING

1. NAME OR DESIGNATION OF PROGRAM - PTH1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM CALCULATES CONTAINMENT SHELL PRESSURE-TEMPERATURE HISTORY RESULTING FROM AQUEOUS COOLANT SYSTEM BLOWDOWN.
4. METHOD OF SOLUTION - THE CONTAINMENT SHELL STRUCTURE IS REPRESENTED AS A GROUP OF SLABS WHOSE TEMPERATURES AND THERMAL FLUXES ARE FOUND BY SOLVING DIFFERENCE EQUATIONS WHICH DESCRIBE THE SLABS. THE CONTAINED GAS PRESSURE AND TEMPERATURE ARE CALCULATED BY USING IDEAL GAS LAW RELATIONS. THE SLAB VALUES AND THE CONTAINED GAS VALUES ARE COUPLED IN THE SOLUTION BY A FORWARD DIFFERENCE METHOD.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
3 MATERIALS FOR EACH SLAB
THE TOTAL NUMBER OF SLABS THAT CAN BE REPRESENTED IS A FUNCTION OF THE OBJECT PROGRAM SIZE AND THE NUMBER OF NODES DEFINING THE TEMPERATURE PROFILE OF EACH SLAB.
6. TYPICAL RUNNING TIME - THE RUNNING TIME IS A FUNCTION OF THE NUMBER OF SLABS, NUMBER OF NODES PER SLAB, AND THE FREQUENCY OF PRINT-OUT CYCLES. FOR EXAMPLE, A PROBLEM CONSISTING OF ELEVEN SLABS WITH APPROXIMATELY FIFTY NODES PER SLAB, A CALCULATION CYCLE OF 0.01 HOUR (ΔT), AND A PRINT-OUT EVERY FIFTY CYCLES REQUIRED ABOUT SIX MINUTES OF 7094 MACHINE TIME TO SIMULATE A TWENTY-FOUR HOUR PERIOD.
7. UNUSUAL FEATURES OF THE PROGRAM - THE CODE IS DIVIDED INTO A NUMBER OF SUBROUTINES. FOR EXAMPLE, THERE ARE TWO TYPES OF SLAB SUBROUTINES, ONE TYPE REPRESENTING THE MATERIAL INSIDE THE CONTAINMENT VESSEL AND THE OTHER TYPE REPRESENTING THE WALLS OF THE CONTAINMENT VESSEL.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED NOVEMBER 1964.
IBM7094 VERSION SUBMITTED SEPTEMBER 1964.
10. REFERENCE - E. R. MCLAUGHLIN, J. S. BUSCH, AND W. D. HARRINGTON, PTH-1 CODE PACKAGE IBM 7094, PRESSURE-TEMPERATURE HISTORY PROGRAM, JUNE 1964.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM7094 FORTRAN II MONITOR.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
J. S. BUSCH, KAISER ENGINEERS
W. D. HARRINGTON, KAISER ENGINEERS
KAISER INDUSTRIES CORPORATION
KAISER CENTER
300 LAKESIDE DRIVE
OAKLAND, CALIFORNIA 94604

E. R. MCLAUGHLIN
ALEXANDER AND ASSOCIATES
TIBURON, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3931 CARDS)
BINARY DECK (940 CARDS)
SAMPLE PROBLEM (482 CARDS)
REFERENCE MEMORANDUM
17. CATEGORY - G
KEYWORDS - CONTAINMENT SHELLS, TEMPERATURE DISTRIBUTION, PRESSURE
DISTRIBUTION, COOLANTS, BLOWDOWN

1. NAME OR DESIGNATION OF PROGRAM - EXTERMINATOR/EXTERMINATOR2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090,360
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE MULTIGROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y, R-Z, OR R-THETA GEOMETRY.
4. METHOD OF SOLUTION - THE EQUIPOISE METHOD (REFERENCE 2) IS EMPLOYED TO SOLVE THE FINITE-DIFFERENCE ANALOGS OF THE MULTIGROUP NEUTRON DIFFUSION EQUATIONS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - IN EXTERMINATOR -
 LET $IMAX$ = MAXIMUM NUMBER OF ROWS
 $JMAX$ = MAXIMUM NUMBER OF COLUMNS
 $KMAX$ = MAXIMUM NUMBER OF GROUPS
 $MMAX$ = MAXIMUM NUMBER OF DIFFERENT COMPOSITIONS
 $NMAX$ = MAXIMUM NUMBER OF NUCLIDES

THEN $IMAX$ MUST BE BETWEEN 3 AND 250
 $JMAX$ MUST BE BETWEEN 3 AND 250
 $KMAX$ MUST BE BETWEEN 1 AND 50
 $MMAX$ MUST BE BETWEEN 1 AND 400
 $IMAX \cdot JMAX$ MUST BE BETWEEN 9 AND 20000
 $IMAX \cdot KMAX$ MUST BE BETWEEN 3 AND 2000
 $JMAX \cdot (15 + KMAX)$ MUST BE BETWEEN 18 AND 2000
 $MMAX \cdot NMAX$ MUST BE BETWEEN 0 AND 6300
 $KMAX \cdot MMAX$ MUST BE BETWEEN 1 AND 1000
 $KMAX \cdot 2 \cdot MMAX$ MUST BE BETWEEN 1 AND 10000

SINCE VARIABLE DIMENSIONING TECHNIQUES AVAILABLE IN FORTRAN IV WERE USED IN EXTERMINATOR2, THE ONLY RESTRICTION ON THE SIZE OF THE PROBLEM IS THE AVAILABLE CORE STORAGE. THE CODE EXAMINES THE SIZE OF EACH PROBLEM AND STORES FLUXES AND EQUATION COEFFICIENTS (EXCEPT FOR SCATTERING MATRIX COEFFICIENTS WHICH ARE RECALCULATED AT EACH ITERATION) ACCORDING TO THE CORE SIZE OF THE MACHINE IN ONE OF FOUR WAYS -

- (1) ALL FLUXES AND EQUATION COEFFICIENTS ARE CONTAINED IN CORE AND NO I/O DEVICES ARE USED DURING THE ITERATIVE PART OF THE CALCULATION.
- (2) ALL EQUATION COEFFICIENTS ARE CONTAINED IN CORE AND I/O DEVICES ARE USED TO STORE THE FLUXES.
- (3) THE FLUXES ARE CONTAINED IN CORE AND I/O DEVICES ARE USED TO STORE THE EQUATION COEFFICIENTS.
- (4) BOTH THE COEFFICIENTS AND FLUXES ARE USED FROM I/O DEVICES.

FOR A PROBLEM WHICH HAS I ROWS AND J COLUMNS IN THE MESH, K ENERGY GROUPS, M DIFFERENT MATERIALS, N NUCLIDES, AND L SETS OF SPECIFICATIONS OF COMPOSITION LOCATIONS, THE AMOUNT OF CORE STORAGE REQUIRED FOR VARIABLES, WHEN ALL FLUXES AND EQUATION COEFFICIENTS ARE USED FROM I/O DEVICES, IS

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM (CONTINUED)

$$4*I + 24*J + 16*K + 2*M + 6*N + (2*M + N + 1)*K**2 + 8*I*J + 14*J*K + 15*M*K + M*N + 4*N*K + 5*L + 8$$

WORDS. THE CORE STORAGE REQUIRED TO BE ABLE TO CONTAIN THE FLUXES AND COEFFICIENTS IN CORE IS

$$4*I + 24*J + 16*K + 2*M + 6*N + (2*M + N + 1)*K**2 + 8*I*J + 4*J*K + 15*M*K + M*N + 4*N*K + 5*L + 8*I*J*K + 10$$

IF ALL CROSS SECTIONS ARE IN MACROSCOPIC FORM, N IS SET TO 1 IN THE ABOVE EXPRESSIONS.

6. TYPICAL RUNNING TIME - THE RUNNING TIME OF A PROBLEM WILL DEPEND UPON THE SIZE OF THE PROBLEM, THE COMPUTER, THE COMPILER AND OPERATING SYSTEM BEING USED, AND THE AMOUNT OF I/O REQUIRED DURING THE ITERATIVE PART OF THE CALCULATION. THE FOLLOWING TABLE GIVES THE RUNNING TIMES AND RATES OF SOME TYPICAL PROBLEMS RUN ON THE IBM360/75 COMPUTER USING THE IBM FORTRAN IV COMPILER WITH LEVEL 2 OPTIMIZATION AND OPERATING SYSTEM/360. THE MACHINE HAS A 512K BYTE CORE MEMORY PLUS 1024K BYTES OF LARGE CAPACITY STORAGE.

MESH SIZE	GROUPS	2311 DISK	NO.ITER.	TIME(MIN)	RATE
31 X 31	3	NO	83	3	0.0007
42 X 25	9	NO	151	17	0.0007
31 X 81	9	NO	92	28	0.0008
51 X 51	25	YES	149	255	0.0016

IN EXTERMINATOR THE CALCULATION RATE VARIES FROM 0.0016 TO 0.0035 SECOND PER POINT PER ITERATION PER GROUP. THE RUNNING TIMES OF SOME TYPICAL PROBLEMS WERE -

POINTS	GROUPS	NO.ITER.	TIME(MIN)	RATE
2500	2	100	15	0.0018
2254	4	85	37	0.0029
2597	7	117	86	0.0024
1681	16	106	162	0.0034

7. UNUSUAL FEATURES OF THE PROGRAM -

EXTERMINATOR AND EXTERMINATOR2 -

- (A) THREE OUTER-BOUNDARY CONDITIONS MAY BE IMPOSED - ZERO FLUX, ZERO NORMAL DERIVATIVE, OR PERIODIC. THE LOGARITHMIC BOUNDARY CONDITION MAY ALSO BE SPECIFIED, EITHER ALONG BOUNDARIES OR INTERNAL TO THE MESH.
- (B) THE CODE ALLOWS NEUTRON SCATTERING FROM ANY GROUP TO ANY OTHER GROUP.

EXTERMINATOR -

- (A) EIGENVALUE PROBLEMS, CONSTANT SOURCE PROBLEMS, OR POISON SEARCH PROBLEMS MAY BE SOLVED.
- (B) INPUT CROSS SECTIONS MAY BE MACROSCOPIC, MICROSCOPIC, OR BOTH. MICROSCOPIC CROSS SECTIONS MAY BE USED FROM A PREVIOUSLY MADE TAPE, FROM CARDS, OR BOTH.

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)

- (C) EITHER POINT RELAXATION OR SINGLE-LINE RELAXATION MAY BE USED IN THE SOLUTION OF A PROBLEM. CONVERGENCE IS ACCELERATED BY MEANS OF THE EXTRAPOLATED LIEBMAN PROCESS IN WHICH THE EXTRAPOLATED LIEBMAN COEFFICIENT IS MADE TO VARY AS NECESSARY DURING THE COURSE OF A CALCULATION TO OBTAIN REASONABLE CONVERGENCE RATES. WHEN THE CONVERGENCE RATE DROPS BELOW A CERTAIN LEVEL, THE FLUXES ARE EXTRAPOLATED BY MEANS OF THE AITKEN DELTA-SQUARED PROCESS. IN CELL PROBLEMS AND IN PROBLEMS IN WHICH THE GROUPS ARE NOT WELL-COUPLED, A GROUP REBALANCING PROCEDURE IS USED TO ACCELERATE CONVERGENCE.
- (D) THE LEVEL OF CONVERGENCE OF A PROBLEM IS INDICATED BY POINTWISE FLUX CONVERGENCE, EIGENVALUE CONVERGENCE, A POINTWISE FLUX CONVERGENCE CRITERION MODIFIED BY THE ESTIMATED RATE OF CONVERGENCE, AND NEUTRON BALANCES FOR EACH GROUP.

EXTERMINATOR2 -

- (A) EIGENVALUE PROBLEMS, CONSTANT SOURCE PROBLEMS, POISON SEARCH PROBLEMS, AND NUCLIDE DENSITY SEARCH PROBLEMS MAY BE SOLVED BY DIRECT ITERATION WITH THE UNKNOWN TREATED AS THE EIGENVALUE OF THE PROBLEM. INDIRECT SEARCH BY SOLUTION OF SUCCEEDING EIGENVALUE PROBLEMS IS ALSO INCLUDED. SPECIAL NEUTRON PROBLEMS CAN BE SOLVED IN WHICH SOME OF THE FLUXES ARE NEGATIVE.
- (B) THE EFFECT ON THE MULTIPLICATION FACTOR AND THE FLUXES DUE TO POINTWISE EQUILIBRIUM XENON CONCENTRATIONS MAY BE TAKEN INTO ACCOUNT.
- (C) THE CODE WILL CALCULATE ADJOINT FLUXES AND DO PERTURBATION CALCULATIONS.
- (D) FLUX-WEIGHTED BROAD-GROUP MICROSCOPIC CROSS SECTIONS MAY BE CALCULATED.
- (E) SUCCEEDING CASES REQUIRE ONLY THOSE INPUT DATA WHICH ARE DIFFERENT FROM THE INPUT FROM THE PRECEDING CASE.
- (F) OPTIONAL OUTPUT INCLUDES POINT-GROUP FLUXES AS NEUTRONS PER CM**2 -SECOND, POINT NEUTRON DENSITY AS NEUTRONS PER CM**3, POINT SOURCE DENSITY AS FISSIONS PER CM**3 -SECOND OR NEUTRON PRODUCTIONS PER CM**3 -SECOND, NUCLIDE REACTION RATES, TOTAL AND COMPOSITION NEUTRON BALANCES, AND CUMULATIVE HEATING ALONG DEFINED COOLANT CHANNELS.

8. RELATED AND AUXILIARY PROGRAMS - EXTERMINATOR IS EXPECTED TO REPLACE THE SLOWER FEW-GROUP DIFFUSION CODE, 20GRAND (ACC ABSTRACT 401). EXTERMINATOR2 IS A FORTRAN IV VERSION OF THE CODE EXTERMINATOR WITH MAJOR IMPROVEMENTS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
 IBM7090 VERSION SUBMITTED MARCH 1965.
 IBM360 VERSION SUBMITTED MAY 1967.

10. REFERENCES - T. B. FOWLER, M. L. TOBIAS AND D. R. VONDY, EXTERMINATOR-2 A FORTRAN IV CODE FOR SOLVING MULTIGROUP NEUTRON DIFFUSION EQUATIONS IN TWO DIMENSIONS, ORNL-4078, APRIL 1967.

10. REFERENCES (CONTINUED)

M. L. TOBIAS AND T. B. FOWLER, THE EQUIPOISE METHOD - A SIMPLE PROCEDURE FOR GROUP-DIFFUSION CALCULATIONS IN TWO AND THREE DIMENSIONS, NUCLEAR SCIENCE AND ENGINEERING, VOL. 12, PP. 513-518, 1962.

T. B. FOWLER, M. L. TOBIAS, AND D. R. VONDY, EXTERMINATOR - A MULTIGROUP CODE FOR SOLVING NEUTRON DIFFUSION EQUATIONS IN ONE AND TWO DIMENSIONS, ORNL-TM-842, JULY 1966.

11. MACHINE REQUIREMENTS - EXTERMINATOR - IBM7090 WITH 32K CORE, ON-LINE PRINTER, AND A MINIMUM OF 7 CHANNEL A TAPE UNITS (INCLUDING SYSTEM TAPE, INPUT TAPE AND OUTPUT TAPE), AND 5 CHANNEL B TAPE UNITS. AN ADDITIONAL CHANNEL B TAPE UNIT IS REQUIRED IF CROSS SECTIONS ARE IN MICROSCOPIC FORM. EXTERMINATOR2 - A MACHINE WITH A MINIMUM OF ABOUT 64K WORDS OF CORE STORAGE AND 5 I/O DEVICES FOR TEMPORARY STORAGE IN ADDITION TO THOSE FOR INPUT DATA AND PRINTED OUTPUT. SOME PROBLEMS MAY REQUIRE 4 ADDITIONAL I/O DEVICES.
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP (EXTERMINATOR) AND FORTRAN IV (EXTERMINATOR2)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN II, VERSION 2 MONITOR SYSTEM DESIGNATED IBM-709FD-062 (EXTERMINATOR) AND OS/360 (EXTERMINATOR2).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - EXTERMINATOR CONSISTS OF 6 CHAIN LINKS COMPRISING APPROXIMATELY 7000 STATEMENTS. EXTERMINATOR2 CAN BE MADE TO CONFORM TO MACHINES OF DIFFERENT CORE SIZES SIMPLY BY ADJUSTING THE FIXED DIMENSION OF ONLY ONE VARIABLE IN A SHORT MASTER PROGRAM. THE CODE COMPILED UNDER THE IBM FORTRAN IV COMPILER ON THE IBM360 COMPUTER IS ABOUT 35000 WORDS LONG BUT CAN BE SHORTENED BY AS MUCH AS ONE-HALF THIS LENGTH BY REMOVING SOME OF THE SUBROUTINES WHICH DO OPTIONAL CALCULATIONS. USING THE OVERLAY FEATURE OF THE IBM360 OPERATING SYSTEM, THE STORAGE REQUIREMENTS CAN BE REDUCED TO ABOUT 15000 WORDS.
15. NAME AND ESTABLISHMENT OF AUTHORS -
T. B. FOWLER, M. L. TOBIAS, AND D. R. VONDY
OAK RIDGE NATIONAL LABORATORY
P. O. BOX X
OAK RIDGE, TENNESSEE 37831
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7090-7589 CARDS AND 360-6645 CARDS)
SAMPLE PROBLEMS (7090-56 CARDS AND 360-69 CARDS)
REFERENCE REPORTS, ORNL-4078 AND ORNL-TM-842
17. CATEGORY - C
KEYWORDS - DIFFUSION EQUATIONS, 2-DIMENSIONAL, MULTIGROUP, X-Y, R-Z, R-THETA, REACTIVITY, FLUX DISTRIBUTION

REACTOR CODE ABSTRACT 159

10/67

1. NAME OR DESIGNATION OF PROGRAM - MOMUS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - MOMUS IS THE PROGRAM USED TO CONSTRUCT AND MAINTAIN THE NEUTRON CROSS SECTION MASTER TAPE DEVELOPED UNDER THE ATOMICS INTERNATIONAL AUTOMATED CROSS SECTION PROGRAM. THE LIBRARY CONTAINS 21 ELEMENTS WITH DATA FOR 11 PARAMETERS IN THE RANGE 0.001 EV TO 10 MEV. MOMUS WILL PERFORM THE FOLLOWING TASKS -
 - (A) MAKE THE BINARY MASTER TAPE FROM CARDS,
 - (B) LIST SELECTED ELEMENTS,
 - (C) UPDATE - ADD, CORRECT AND REPLACE ANY DATA,
 - (D) MAKE A SHORT TAPE CONTAINING SELECTED ELEMENTS,
 - (E) PROVIDE GRAPHICAL DISPLAY OF SELECTED DATA, AND
 - (F) PUNCH MICROSCOPIC DATA.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - PARAMETERS ARE TABULATED AT 90 UNIFORM POINTS IN ENERGY PER DECADE FOR A TOTAL OF 901 POINTS.
6. TYPICAL RUNNING TIME - THE PROGRAM REQUIRES TEN MINUTES FOR GRAPHICAL DISPLAY OF ALL PARAMETERS OF ALL ELEMENTS, ONE-HALF MINUTE TO LIST ONE ELEMENT, AND TWO MINUTES FOR ADDITIONS OR CORRECTIONS WITH CHECKING.
7. UNUSUAL FEATURES OF THE PROGRAM - MOMUS IS WRITTEN IN SUCH A WAY THAT EACH SUBROUTINE PERFORMS A SPECIFIC TASK. THUS FOR EACH OPTION, THE MAIN PROGRAM CALLS THE REQUIRED ROUTINES IN THE PROPER ORDER. THIS PHILOSOPHY MAKES PROGRAM MODIFICATION QUITE EASY.
8. RELATED AND AUXILIARY PROGRAMS - THE NEUTRON MASTER TAPE IS USED BY -
 - (A) GRAVE (ACC ABSTRACT 162), THE GROUP AVERAGING CODE.
 - (B) PRISM, THE INELASTIC AND ELASTIC SCATTERING MATRICES CODE.
 - (C) PANCAKES, A SPECTRUM ITERATION CODE BASED ON FAIM (ACC ABSTRACT 120).
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
IBM7094 VERSION SUBMITTED FEBRUARY 1965.
10. REFERENCES - R. A. BLAINE, MOMUS, A PROGRAM TO CONSTRUCT, UP-DATE AND MODIFY THE NEUTRON MICROSCOPIC CROSS SECTION MASTER TAPE, NAA-SR-MEMO-8823, AUGUST 1963.
R. A. BLAINE, MODIFICATIONS TO MOMUS, ATOMICS INTERNATIONAL INTERNAL LETTER, OCTOBER 21, 1964.
M. HOFFMAN AND W. A. RHOADES, AICRT-3, A GENERAL CODE FOR DISPLAY OF DIGITAL DATA, NAA-SR-MEMO-9069, OCTOBER 1963.

11. MACHINE REQUIREMENTS - 32K IBM7094, SC-4020 GRAPHICAL DISPLAY DEVICE
12. PROGRAMMING LANGUAGES USED - FORTRAN II (90 PER CENT)
FAP (10 PER CENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD IBM FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
IF AN SC-4020 GRAPHICAL DISPLAY DEVICE IS NOT AVAILABLE, A DUMMY
ROUTINE CAN BE USED OR ATCRT 3 CAN BE REWRITTEN.
THE NAA SC-4020 SUBROUTINE PACKAGE IS AVAILABLE THROUGH -
UAIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
MOMUS SOURCE DECK (1700 BCD RECORDS)
CROSS SECTION LIBRARY (23,013 BCD RECORDS)
REFERENCE REPORTS AND LETTER
17. CATEGORY - M
KEYWORDS - CROSS SECTIONS, LIBRARIES, PREPARATION, MAINTENANCE,
RETRIEVAL GRAPHS

REACTOR CODE ABSTRACT 160

10/67

1. NAME OR DESIGNATION OF PROGRAM - SOPHIST
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - SOPHIST1 CALCULATES TEMPERATURE-DEPENDENT MULTIGROUP ENERGY TRANSFER COEFFICIENTS FOR A MAXWELL GAS MODERATOR WITH ELASTIC, ISOTROPIC SCATTERING IN THE CENTER OF MASS SYSTEM. SOPHIST2 CALCULATES TEMPERATURE-DEPENDENT MULTIGROUP CROSS SECTIONS FOR A MAXWELL GAS. SOPHIST5 CALCULATES MULTIGROUP ENERGY TRANSFER MATRICES FOR ANISOTROPIC ELASTIC SCATTERING.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

SOPHIST1	UP TO 120 ENERGY GROUPS.
SOPHIST2	UP TO 90 ENERGY GROUPS, 100 RESONANCES, 400 POINTWISE CROSS SECTIONS, AND 131 POINTWISE WEIGHTING FLUXES PLUS ANALYTIC FORMS.
SOPHIST5	UP TO 120 ENERGY GROUPS WITH DIFFERENTIAL CROSS SECTION INPUT FOR UP TO 200 INPUT ENERGIES, AND WEIGHTING FLUXES FOR UP TO 200 INPUT ENERGIES.
6. TYPICAL RUNNING TIME -

SOPHIST1	2 MINUTES FOR 75-GROUP ROOM TEMPERATURE PROBLEM.
SOPHIST2	10-15 MINUTES FOR 25-30 RESONANCES AT ROOM TEMPERATURE.
SOPHIST5	3 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM -

SOPHIST1	UP OR DOWN-SCATTER TO ANY NUMBER OF GROUPS. ANALYTIC INTEGRATION OVER THE FINAL ENERGY GROUP HAS REDUCED THE EQUATIONS TO 1-DIMENSIONAL INTEGRALS EVALUATED BY REPEATED HALVING UNTIL CONVERGENCE IS ATTAINED. A VARIABLE MODERATOR MASS OPTION IS INCLUDED FOR APPROXIMATING CHEMICAL BINDING EFFECTS.
SOPHIST2	HANDLES SINGLE-LEVEL BREIT-WIGNER RESONANCES, $1/v$, ARBITRARY POINTWISE, OR POINTWISE DEVIATIONS FROM $1/v$ CROSS SECTIONS. CALCULATES FLUX DEPRESSION FOIL FACTORS. USES THE PRECISE EQUATION FOR AVERAGING OVER MOTION AT THE MAXWELL GAS TARGET MOTION, RATHER THAN NARROW RESONANCE APPROXIMATION.
SOPHIST5	OUTPUT IN PROPER FORM FOR DIFFUSION AND TRANSPORT-CORRECTED SN CODES.

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
INPUT DIFFERENTIAL CROSS SECTIONS AS LEGENDRE EXPANSIONS THROUGH $L = 6$.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
IBM7090 VERSIONS SUBMITTED OCTOBER 1964.
10. REFERENCES - E. CANFIELD, R. STUART, R. FREIS, AND W. COLLINS, SOPHIST I-AN IBM709/7090 CODE WHICH CALCULATES MULTIGROUP TRANSFER COEFFICIENTS FOR GASEOUS MODERATORS, UCRL-5956, OCTOBER 19, 1961.
E. CANFIELD AND J. PETTIBONE, SOPHIST II, A GROUP CROSS SECTION IBM709/7090 CODE, UCRL-6912, MAY 21, 1962.
E. CANFIELD, SOPHIST-5, AN IBM7090/7094 FORTRAN II CODE WHICH CALCULATES MULTIGROUP ENERGY TRANSFER MATRICES FOR ANISOTROPIC ELASTIC SCATTERING OF NEUTRONS, UCRL-7624, DECEMBER 18, 1963.
11. MACHINE REQUIREMENTS - 32K MACHINE
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD IBM FORTRAN II MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
SOPHIST-5 USES TAPE A6 IN ADDITION TO NORMAL MONITOR SYSTEM REQUIREMENTS.
CALL DUMP DUMPS MEMORY TO HIGH SPEED PRINT TAPE (AT LRL, CONTROLLED BY MONITOR JOB CARD) AND CALLS EXIT (RETURNS TO MONITOR) UPON DUMP COMPLETION.
15. NAME AND ESTABLISHMENT OF AUTHORS -
E. H. CANFIELD AND STUART STONE
LAWRENCE RADIATION LABORATORY
P. O. BOX 808
LIVERMORE, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (SOPHIST1 3438 CARDS, SOPHIST2 822 CARDS, SOPHIST5 1583 CARDS)
SAMPLE PROBLEM (SOPHIST5 132 CARDS)
E3 DATA (SOPHIST2 50 CARDS)
REFERENCE REPORTS
FIRST 3 ITEMS LISTED ARE DISTRIBUTED AS A SINGLE TAPE TOGETHER WITH A DESCRIPTION OF THE TAPE CONTENTS.
17. CATEGORY - B
KEYWORDS - ELASTIC SCATTERING, MULTIGROUP GROUP CONSTANTS, TEMPERATURE, ANISOTROPIC SCATTERING, ISOTROPIC SCATTERING, GASES, MODERATORS, BREIT-WIGNER FORMULA

1. NAME OR DESIGNATION OF PROGRAM - FORTRAN TDC
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B
3. NATURE OF PHYSICAL PROBLEM SOLVED - TDC SOLVES THE BOLTZMANN EQUATION IN MULTIGROUP FORM FOR THE TRANSPORT OF NEUTRONS OR THE ADJOINT EQUATION IN FINITE (R,Z) CYLINDRICAL GEOMETRY BY THE DISCRETE SN METHOD. THE PROBLEM MAY BE HOMOGENEOUS (NO SOURCES INDEPENDENT OF FLUXES) OR INHOMOGENEOUS, BUT ALL SOURCES MUST BE ISOTROPIC. NEUTRON SCATTERING MUST ALSO BE ISOTROPIC. A HOMOGENEOUS PROBLEM MAY BE SOLVED FOR THE EIGENVALUE K-EFF OR THE EIGENVALUE ALPHA (TIME CONSTANT). ALTERNATIVELY, THE HOMOGENEOUS PROBLEM MAY BE SOLVED FOR THE SIZE (RADIUS, HEIGHT OR BOTH) OF THE SYSTEM CORRESPONDING TO A SPECIFIED K-EFF OR FOR THE ATOM CONCENTRATION OF SOME MATERIAL CORRESPONDING TO A SPECIFIED EIGENVALUE K-EFF OR ALPHA. FOR INHOMOGENEOUS PROBLEMS, THE IMPOSED SOURCE MAY BE AN ISOTROPIC VOLUME-DISTRIBUTED SOURCE OR AN ISOTROPIC SHELL SOURCE ON THE OUTER BOUNDARY.
4. METHOD OF SOLUTION - TDC USES THE DISCRETE SN METHOD OF B. CARLSON (SEE REFERENCE 1 BELOW).
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - FORTRAN TDC USES A VARIABLE ARRAY LENGTH TECHNIQUE, HENCE THE ONLY RESTRICTION IMPOSED ON THE DATA IS THAT THE NUMBER OF CORE LOCATIONS RESERVED FOR DATA CANNOT EXCEED 23,200. THIS DEPENDS SOMEWHAT ON THE MONITOR SYSTEM BEING USED.
6. TYPICAL RUNNING TIME - THE RUNNING TIME IS A FUNCTION OF NUMBER OF GROUPS, NUMBER OF SPACE POINTS, THE ORDER OF SN APPROXIMATION, AND THE PRECISION DESIRED. AN S₂, 16-GROUP, K-EFF CALCULATION WITH 361 SPACE POINTS TAKES APPROXIMATELY 100 MINUTES (900 INNER ITERATIONS). THIS INCLUDES ON-LINE PRINTING OF THE OUTPUT. THE OPTIONAL ON-LINE EDIT OF ANGULAR FLUXES WOULD REQUIRE APPROXIMATELY 20-30 MINUTES MORE.
7. UNUSUAL FEATURES OF THE PROGRAM - ALL FEATURES CONTAINED IN THE FLOCO VERSION OF TDC HAVE BEEN RETAINED. THE FOLLOWING FEATURES WERE ADDED.
 - (A) OPTION TO PRINT AND WRITE ON TAPE AVERAGE ANGULAR FLUXES FOR EACH DIRECTION, INTERVAL AND GROUP. OPTION TO PRINT ANGULAR FLUXES LOCATED ON ALL RADIAL AND AXIAL BOUNDARIES BY DIRECTION, INTERVAL AND GROUP.
 - (B) FOR A GIVEN AXIAL PLANE, CALCULATION OF
 - (1) NET CURRENT BY RADIAL INTERVAL AND GROUP,
 - (2) CURRENT IN DIRECTION OF POSITIVE MU BY RADIAL INTERVAL AND GROUP,
 - (3) RADIAL- AND GROUP-DEPENDENT NEUTRON DIRECTION PROBABILITIES FOR POSITIVE MU,
 - (4) TOTAL AND GROUP-DEPENDENT AXIAL LEAKAGE BY REGION.

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
(C) FOR THE OUTSIDE CYLINDRICAL SURFACE, CALCULATION OF AXIALLY- AND GROUP-DEPENDENT NEUTRON DIRECTION PROBABILITIES FOR POSITIVE MU AND INCREASING R.
8. RELATED AND AUXILIARY PROGRAMS - FLDCO TDC
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
CDC1604B VERSION SUBMITTED JANUARY 1965.
10. REFERENCES - B. CARLSON, ET AL., THE DSN AND TDC NEUTRON TRANSPORT CODES, LAMS-2346, 1959.
B. CARLSON, NUMERICAL SOLUTION OF TRANSIENT AND STEADY-STATE NEUTRON TRANSPORT PROBLEM, LA-2260, 1959.
W. J. FADER, R. J. RODGERS, F. R. MYNATT, AND R. E. LAWRENCE, THE TDC CODE, PRATT AND WHITNEY AIRCRAFT - CANEL, TIM-847, SEPTEMBER 1964.
R. J. RODGERS AND P. S. CHECK, USERS GUIDE TO FORTRAN TDC, PRATT AND WHITNEY AIRCRAFT - CANEL, TIM-890, FEBRUARY 1965.
11. MACHINE REQUIREMENTS - 32K WITH 2 TAPE UNITS PLUS INPUT AND OUTPUT UNITS
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD CDC COOP MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - FORTRAN TDC IS WRITTEN AS AN OVERLAY PROGRAM. PROGRAM FLOW IS ESSENTIALLY THE SAME AS FLOCO TDC.
15. NAME AND ESTABLISHMENT OF AUTHORS -
FORTRAN VERSION - C. E. KELLER
PRATT AND WHITNEY AIRCRAFT - CANEL
MIDDLETOWN, CONNECTICUT

FORTRAN VERSION - R. J. RODGERS AND W. J. FADER
OAK RIDGE NATIONAL LABORATORY
P. O. BOX X
OAK RIDGE, TENNESSEE 37831

TDC B. CARLSON, ET AL.
LOS ALAMOS SCIENTIFIC LABORATORY
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2964 CARDS)
SAMPLE PROBLEM (66 CARDS)
REFERENCE REPORTS, TIM-847 AND TIM-890

REACTOR CODE ABSTRACT 161

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17. CATEGORY - C
KEYWORDS - SN METHOD, 2-DIMENSIONAL, MULTIGROUP, R-Z, CRITICALITY
SEARCHES

1. NAME OR DESIGNATION OF PROGRAM - GRAVE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - GRAVE IS THE PROGRAM TO FORM GROUP-AVERAGED CROSS SECTIONS USING THE NEUTRON CROSS SECTION MASTER TAPE DEVELOPED UNDER THE ATOMICS INTERNATIONAL AUTOMATED CROSS SECTION PROGRAM. NINETEEN GROUP-AVERAGED PARAMETERS ARE OBTAINABLE AS FOLLOWS - SIGMA T, SIGMA EL, SIGMA N, SIGMA F, NUBAR, MUBAR, XIBAR, SIGMA IN, SIGMA N-ALPHA, SIGMA N-P, SIGMA N-2N, SIGMA A, SIGMA TR, SIGMA NON-EL, ALPHABAR, XI*SIGMA EL, NU*SIGMA F, MUBAR*SIGMA EL, AND SIGMA R. THE SPECTRUM IS CONSTRUCTED FROM A COMBINATION OF FISSION, E*-N, POWER SERIES, MAXWELLIAN OR INPUT SPECTRA.
4. METHOD OF SOLUTION - GROUP-AVERAGED CROSS SECTIONS ARE OBTAINED BY FLUX WEIGHTING IN NON-RESONANCE GROUPS AND BY THE USE OF ARES II FOR RESONANCE GROUPS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF GROUPS = 300
MAXIMUM NUMBER OF ELEMENTS = 21
MAXIMUM NUMBER OF FLUX REGIONS = 5
6. TYPICAL RUNNING TIME - TWENTY-ONE ELEMENTS WITH ALL NINETEEN PARAMETERS CAN BE PROCESSED IN SIX MINUTES USING 18 AND 54 GROUPS.
7. UNUSUAL FEATURES OF THE PROGRAM - GRAVE REQUIRES THE NEUTRON CROSS SECTION MASTER TAPE PREPARED BY THE MOMUS PROGRAM. PUNCHED OUTPUT IS AVAILABLE ON OPTION.
8. RELATED AND AUXILIARY PROGRAMS -
(A) MOMUS (ACC ABSTRACT 159) - PREPARES AND UPDATES NEUTRON CROSS SECTION MASTER TAPE.
(B) PRISM - PRODUCES ELASTIC, INELASTIC AND TOTAL TRANSFER MATRICES.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
IBM7094 VERSION SUBMITTED FEBRUARY 1965.
10. REFERENCES - R. A. BLAINE AND J. S. TEMPLE, GRAVE, A GROUP CROSS SECTION AVERAGING PROGRAM, NAA-SR-MEMO-9276, DECEMBER 1963.
R. A. BLAINE, MODIFICATION OF THE GRAVE PROGRAM, ATOMICS INTERNATIONAL INTERNAL LETTER, JANUARY 1965.
F. L. FILLMORE AND B. D. OREILLY, ARES II, A RESONANCE INTEGRAL CODE, NAA-SR-MEMO-8889, AUGUST 1963.
R. A. BLAINE, MOMUS, A PROGRAM TO CONSTRUCT, UP-DATE AND MODIFY THE NEUTRON MICROSCOPIC CROSS SECTION MASTER TAPE, NAA-SR-MEMO-8823, AUGUST 1963.
11. MACHINE REQUIREMENTS - 32K MEMORY

REACTOR CODE ABSTRACT 162

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10/67

12. PROGRAMMING LANGUAGES USED - FORTRAN II (95 PER CENT)
FAP (5 PER CENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD IBM FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
GRAVE SOURCE DECK, INCLUDING ARES II (3500 CARDS)
SAMPLE PROBLEM (23 CARDS)
ARES LIBRARY (500 CARDS)
REFERENCE REPORTS, NAA-SR-MEMO-9276 AND NAA-SR-MEMO-8889, AND
LETTER
17. CATEGORY - 8
KEYWORDS - CROSS SECTIONS AVERAGES, MAXWELL DISTRIBUTION, MULTI-
GROUP GROUP CONSTANTS

1. NAME OR DESIGNATION OF PROGRAM - AIROS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094,360
3. NATURE OF PHYSICAL PROBLEM SOLVED - AIROS SOLVES THE SPACE-INDEPENDENT REACTOR KINETICS EQUATIONS AND PROVIDES FOR THE DETERMINATION OF REACTIVITY BY SOLVING IN ADDITION THE DISCRETIZED EQUATIONS WHICH REPRESENT THE SPATIAL HEAT AND MASS TRANSFER MODEL FOR SEVERAL FUEL CHANNELS. IN ADDITION, VARIATION OF THE FILM COEFFICIENT WITH FLOW IS ACCOUNTED FOR AS WELL AS THE PROVISION FOR FLOW DECAY AND AFTERGLOW HEATING. SCRAMS CAN BE INITIATED BY DELAYED SIGNALS FROM INSTRUMENTS WHICH SENSE ANY QUANTITY CALCULATED, E.G., POWER, INVERSE PERIOD OR TEMPERATURE. GENERALIZED FEEDBACK EQUATIONS ARE USED TO PROVIDE FLEXIBILITY IN THE MODELS THAT REPRESENT MULTICHANNEL HEAT TRANSFER INCLUDING CONDUCTION AND CONVECTION, ENERGY, PRESSURE AND OTHER PHENOMENON. THE REACTIVITY EQUATION IS ALSO GENERALIZED. THE REACTIVITY FEEDBACK COEFFICIENTS CAN BE CONSTANT OR VARY AS THE SQUARE ROOT OR RECIPROCAL OF TEMPERATURE. FURTHERMORE ANY FEEDBACK VARIABLE CAN BE USED TO INITIATE A REACTIVITY SCRAM, EACH WITH A UNIQUE DELAY TIME.
4. METHOD OF SOLUTION - THE NUMERICAL TECHNIQUE USED TO INTEGRATE THE NEUTRON AND FEEDBACK DIFFERENTIAL EQUATIONS IS THAT DEVELOPED BY E. R. COHEN AS PREVIOUSLY USED IN THE AIREK CODES. AN IMPROVED INTERVAL SWITCHING TECHNIQUE ALLOWS RAPID CALCULATIONS WITH PRE-DETERMINED ACCURACY.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
15 DELAYED NEUTRON PRECURSOR GROUPS.
100 FEEDBACK VARIABLES WITH ANY VARIABLE CONNECTED TO NO MORE THAN 8 OTHERS.
39 FEEDBACK VARIABLES PRINTED.
6. TYPICAL RUNNING TIME - THE PROGRAM REQUIRES ONE TO TWO MINUTES FOR A PROBLEM WITH SIX DELAYED NEUTRON PRECURSOR GROUPS AND 50 FEEDBACK VARIABLES (INCLUDING CRT) ON THE IBM7094. ON THE IBM360 MODEL 50 2 TO 4 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
 - (A) SPECIAL PROVISION IS MADE FOR REACTOR START-UP PROBLEMS RESULTING IN LARGE REDUCTION IN RUNNING TIME.
 - (B) MUCH OF THE REQUIRED INPUT DATA IS PRE-SET BUT CAN BE CHANGED IF DESIRED.
 - (C) ADDRESSABLE INPUT DATA IS USED SO THAT ON MULTIPLE CASES, ONLY CHANGES NEED BE SPECIFIED.
 - (D) A RESTART FEATURE IS PROVIDED WHEREIN RESTART CARDS ARE PUNCHED UPON ABNORMAL PROBLEM TERMINATION AND/OR ON AN INPUT OPTION.
 - (E) EXTENSIVE PRINTED AND GRAPHICAL DISPLAYS ARE PROVIDED AS FOLLOWS - POWER, INVERSE PERIOD, REACTIVITY AND ANY 39 FEEDBACK VARIABLES. PRINTING AND DISPLAY OF FEEDBACK

REACTOR CODE ABSTRACT 163

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7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
VARIABLES IS UNDER USER CONTROL AND THE LATTER CAN
BE GROUPED ON CRT FRAMES AS DESIRED.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
IBM7094 VERSION SUBMITTED MARCH 1965.
IBM360 VERSION SUBMITTED FEBRUARY 1967.
10. REFERENCES - R. A. BLAINE AND R. F. BERLAND, AIROS - A DIGITAL
SIMULATOR FOR POWER REACTOR DYNAMICS, NAA-SR-9943, AUGUST 1964.
R. A. BLAINE, MODIFICATIONS TO AIROS, ATOMICS INTER-
NATIONAL INTERNAL LETTER, OCTOBER 1, 1964.
M. HOFFMAN AND W. A. RHOADES, AICRT 3, A GENERAL CODE
FOR DISPLAY OF DIGITAL DATA, NAA-SR-MEMO-9069, OCTOBER 1963.
R. A. BLAINE AND R. F. BERLAND, AIROS - CONVERSION TO
IBM SYSTEM/360, AI-66-MEMO-170, VOLUME I, DECEMBER 1966.
R. A. BLAINE, AIROS - CONVERSION TO IBM SYSTEM/360 -
FLOWCHARTS, AI-66-MEMO-170, VOLUME II, DECEMBER 1966.
R. A. BLAINE, ATOMICS INTERNATIONAL ENVIRONMENT
REPORT, MAY 1967.
11. MACHINE REQUIREMENTS - 32K IBM7094, SC-4020 GRAPHICAL DISPLAY
DEVICE OR 256K BYTE IBM360
12. PROGRAMMING LANGUAGES USED - FORTRAN II + MAP (7094) AND
FORTRAN IV (H) (360)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBSYS AND OS/360.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
IF AN SC-4020 GRAPHICAL DISPLAY DEVICE IS NOT AVAILABLE, THE
AICRT3 DISPLAY ROUTINE CAN BE REWRITTEN, OTHERWISE LINK 2 CAN BE
DELETED AND AIROS CAN BE RUN AS A NON-OVERLAY JOB WITHOUT CRT.
THE NAA SC-4020 (IBSYS) SUBROUTINE PACKAGE IS AVAILABLE THROUGH -
UAIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7094-2000 CARDS AND 360-1522 CARDS)
OBJECT DECK (360-811 CARDS)
SAMPLE PROBLEMS (7094-173 CARDS AND 360-139 CARDS)
REFERENCE REPORTS AND LETTER, EXCEPT VOLUME II AI-66-MEMO-170.
THESE FLOWCHARTS AVAILABLE ON LOAN ONLY.
17. CATEGORY - E
KEYWORDS - SPACE-INDEPENDENT KINETICS, REACTIVITY, FEEDBACK, HEAT
TRANSFER

REACTOR CODE ABSTRACT 164

10/67

1. NAME OR DESIGNATION OF PROGRAM - BURP1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PROGRAM CALCULATES ABSOLUTE TOTAL EFFICIENCY FOR MONOENERGETIC GAMMA RAY INTERACTIONS IN CYLINDRICAL SCINTILLATION DETECTORS. THE ABSOLUTE TOTAL EFFICIENCY IS DEFINED AS THE FRACTION OF SOURCE GAMMAS WHICH INTERACT AT LEAST ONCE WITH THE CRYSTAL DETECTOR. CALCULATIONS ARE MADE FOR THE POINT ISOTROPIC SOURCE LOCATED ALONG THE AXIS OF SYMMETRY FOR SOLID CYLINDRICAL CRYSTALS, WITH OR WITHOUT A COAXIAL CYLINDRICAL WELL.
4. METHOD OF SOLUTION - USES GAUSSIAN QUADRATURE NUMERICAL INTEGRATION TO EVALUATE INTEGRALS TO FOUR SIGNIFICANT FIGURES. WHEN REQUIRED, USES AITKENS FIFTH-ORDER ITERATIVE FORMULA FOR INTERPOLATION OF CROSS SECTION DATA.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - CALCULATES FOR MONOENERGETIC, SYMMETRICALLY LOCATED, ISOTROPIC POINT-SOURCES IN THE ENERGY RANGE 0.01-30.0 MEV. NEGLECTS ANY MEDIA SURROUNDING CRYSTAL. FOR EACH RUN, THE NUMBER OF DIFFERENT SOURCE-CRYSTAL DISTANCES IS LIMITED TO 12.
6. TYPICAL RUNNING TIME - (PER EFFICIENCY CALCULATION)
CRYSTAL WITH NO WELL, 0.06 SECOND
CRYSTAL WITH WELL, 0.4 SECOND
7. UNUSUAL FEATURES OF THE PROGRAM - FOR WELL-TYPE CRYSTALS SOURCE MAY BE LOCATED WITHIN, AT THE TOP OF, OR OUTSIDE THE WELL. ANY SIZE SCINTILLATION CRYSTAL OF MATERIAL WITH KNOWN TOTAL CROSS SECTIONS (WITHOUT COHERENT SCATTERING) MAY BE SPECIFIED. NA1 TOTAL CROSS SECTIONS ARE STORED WITHIN THE PROGRAM. CALCULATIONS MAY BE MADE AT A PARTICULAR SOURCE ENERGY, OR OVER ANY DESIRED RANGE WITHIN THE ENERGIES 0.01-30.0 MEV. CALCULATIONS MAY BE MADE FOR A SINGLE SOURCE-CRYSTAL DISTANCE, OR A NUMBER OF DISTANCES.
8. RELATED AND AUXILIARY PROGRAMS -
 - (A) FOR ABSOLUTE TOTAL EFFICIENCIES -
 - (1) BURP2 (ACC ABSTRACT 165) SYMMETRICALLY LOCATED ISOTROPIC DISK AND HOMOGENEOUS CYLINDRICAL VOLUME SOURCES (CAN INCLUDE SOURCE ABSORPTION AND SCATTERING).
 - (2) BURP3 (ACC ABSTRACT 166) ISOTROPIC POINT SOURCE LOCATED OFF AXIS OF SYMMETRY.
 - (B) FOR PHOTOFRACTIONS -
 - (1) BURP4 (ACC ABSTRACT 169) CRYSTAL WITH NO WELL, ALL ISOTROPIC AND COLLIMATED SOURCES.
 - (2) BURP5 (ACC ABSTRACT 170) WELL CRYSTAL, ALL ISOTROPIC AND COLLIMATED SOURCES.

9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
IBM7090 VERSION SUBMITTED FEBRUARY 1965.
10. REFERENCES - B. J. SNYDER AND G. L. GYOREY, CALCULATING GAMMA EFFICIENCIES IN SCINTILLATION DETECTORS, NUCLEONICS, VOL. 23, NO. 2, PP. 80-86, FEBRUARY 1965.
B. J. SNYDER, PH.D. THESIS, UNIVERSITY OF MICHIGAN, DEPARTMENT OF NUCLEAR ENGINEERING, 1965, APPENDIX E, INSTRUCTIONS FOR COMPUTER PROGRAMS FOR CALCULATION OF THE ABSOLUTE TOTAL EFFICIENCY AND PHOTOFRACTIONS.
B. J. SNYDER AND G. F. KNOLL, CALCULATED GAMMA RAY PHOTOFRACTIONS FOR WELL-TYPE SCINTILLATION DETECTORS, SUBMITTED TO NUCLEAR INSTRUMENTS AND METHODS, JUNE 1965.
11. MACHINE REQUIREMENTS - 32K IBM7090, 4 TAPES ON CHANNEL A, 4 TAPES ON CHANNEL B. CHANNEL A - 716 PRINTER (USING STANDARD SHARE II BOARD), 711 READER (USING NORMAL DIRECT READ BOARD). OPTIONAL ITEMS - RPQ MO0680 (ADDRESSABLE STORAGE PROTECT), RPQ F89349 (CORE STORAGE CLOCK AND INTERVAL TIMER), ADDITIONAL TAPES. AS THE BINARY MASTER TAPES COME, BOTH RPQS ARE NEEDED. THE SHARE DISTRIBUTION CONTAINS NECESSARY INSTRUCTIONS AND PIECES FOR REASSEMBLY OF REQUIRED PARTS OF SYSTEM WHEN EITHER, OR BOTH, OF THESE RPQS ARE NOT AVAILABLE.
12. PROGRAMMING LANGUAGE USED - MAD (MICHIGAN ALGORITHM DECODER)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - MICHIGAN EXECUTIVE SYSTEM, AVAILABLE FROM DP PROGRAM INFORMATION DEPARTMENT, IBM CORPORATION, WHITE PLAINS, NEW YORK.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
B. J. SNYDER
WESTINGHOUSE ELECTRIC CORPORATION
ASTRONUCLEAR LABORATORY
P. O. BOX 10864
PITTSBURGH, PENNSYLVANIA 15236
16. MATERIAL AVAILABLE -
SOURCE DECK (401 CARDS)
BINARY DECK (156 CARDS)
PROGRAM INSTRUCTIONS
REFERENCE REPORTS
17. CATEGORY - 0
KEYWORDS - EFFICIENCY, GAMMA RADIATION, CRYSTALS, SCINTILLATION COUNTERS

REACTOR CODE ABSTRACT 165

10/67

1. NAME OR DESIGNATION OF PROGRAM - BURP2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PROGRAM CALCULATES THE ABSOLUTE TOTAL EFFICIENCY FOR MONOENERGETIC GAMMA RAYS INTERACTING IN CYLINDRICAL SCINTILLATION DETECTORS. THE ABSOLUTE TOTAL EFFICIENCY IS DEFINED AS THE FRACTION OF SOURCE GAMMAS WHICH INTERACT AT LEAST ONCE WITH THE CRYSTAL DETECTOR. CALCULATIONS ARE MADE FOR HOMOGENEOUS, ISOTROPIC CIRCULAR DISK OR CYLINDRICAL VOLUME SOURCES. SOURCES MUST BE SYMMETRICAL WITH THE AXIS OF SYMMETRY FOR SOLID CYLINDRICAL CRYSTALS, WITH OR WITHOUT A COAXIAL CYLINDRICAL WELL. SOURCE ABSORPTION AND SCATTERING MAY BE INCLUDED FOR VOLUME SOURCES.
4. METHOD OF SOLUTION - USES GAUSSIAN QUADRATURE NUMERICAL INTEGRATION TO EVALUATE INTEGRALS TO FOUR SIGNIFICANT FIGURES. WHEN REQUIRED USES AITKENS FIFTH ORDER ITERATIVE FORMULA FOR INTERPOLATION OF CROSS SECTION DATA.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - CALCULATES FOR MONOENERGETIC, SYMMETRICALLY LOCATED, HOMOGENEOUS CIRCULAR DISK OR CYLINDRICAL VOLUME SOURCES IN THE ENERGY RANGE 0.01-30.0 MEV. NEGLECTS ANY MEDIA SURROUNDING THE CRYSTAL. FOR EACH RUN THE FOLLOWING NUMBER OF DIFFERENT SOURCE-CRYSTAL GEOMETRIES MAY NOT BE EXCEEDED -
 - (A) CIRCULAR DISK SOURCES OF A GIVEN RADIUS -
12 SOURCE-CRYSTAL DISTANCES
 - (B) CYLINDRICAL VOLUME SOURCES OF A GIVEN RADIUS,
AND A GIVEN DISTANCE FROM CRYSTAL TO BOTTOM OF SOURCE
CYLINDER -
12 DIFFERENT SOURCE VOLUME HEIGHTSALL SOURCES MUST BE LOCATED WITHIN THE WELL FOR THE WELL-TYPE CRYSTAL. FOR CRYSTALS WITH NO WELL, ALL SOURCE RADIUS MUST BE LESS THAN, OR EQUAL TO THE CRYSTAL RADIUS. WHEN THE VOLUME SOURCE SCATTERING AND ABSORPTION ARE CONSIDERED, THE SOURCE VOLUME MUST BE THE SAME AS THE WELL VOLUME (FOR THE WELL-TYPE CRYSTAL), OR THE SOURCE RADIUS MUST EQUAL THE CRYSTAL RADIUS (FOR THE CRYSTAL WITH NO WELL).
6. TYPICAL RUNNING TIME - (PER EFFICIENCY CALCULATION)
 - CRYSTAL WITH NO WELL
 - (A) DISK SOURCE - 0.2 SECOND
 - (B) VOLUME SOURCE - 2.2 SECONDS
 - CRYSTAL WITH WELL
 - (A) DISK SOURCE - 1.2 SECONDS
 - (B) VOLUME SOURCE - 14.5 SECONDS
7. UNUSUAL FEATURES OF THE PROGRAM - FOR VOLUME SOURCES OF ANY MATERIAL, GAMMA SCATTERING AND ABSORPTION WITHIN THE SOURCE MAY BE CONSIDERED IF SOURCE MATERIAL TOTAL CROSS SECTIONS (WITHOUT

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
COHERENT SCATTERING) ARE SUPPLIED FOR THE ENERGY RANGE OF INTEREST. ANY SIZE SCINTILLATION CRYSTAL OF MATERIAL WITH KNOWN TOTAL CROSS SECTION (WITHOUT COHERENT SCATTERING) MAY BE SPECIFIED. NAI TOTAL CROSS SECTIONS ARE STORED WITHIN THE PROGRAM. CALCULATIONS MAY BE MADE AT A PARTICULAR SOURCE ENERGY, OR OVER ANY DESIRED RANGE WITHIN THE ENERGIES 0.01-30.0 MEV. CALCULATIONS MAY BE MADE FOR A SINGLE SOURCE-CRYSTAL DISTANCE, OR A NUMBER OF DISTANCES.
8. RELATED AND AUXILIARY PROGRAMS -
 - (A) FOR ABSOLUTE TOTAL EFFICIENCIES -
 - (1) BURP1 (ACC ABSTRACT 164) ISOTROPIC POINT SOURCE ON AXIS OF SYMMETRY.
 - (2) BURP3 (ACC ABSTRACT 166) ISOTROPIC POINT SOURCE LOCATED OFF AXIS OF SYMMETRY.
 - (B) FOR PHOTOFRACTIONS -
 - (1) BURP4 (ACC ABSTRACT 169) SOLID CRYSTAL, ALL ISOTROPIC AND COLLIMATED SOURCES.
 - (2) BURP5 (ACC ABSTRACT 170) WELL CRYSTAL, ALL ISOTROPIC AND COLLIMATED SOURCES.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
IBM7090 VERSION SUBMITTED FEBRUARY 1965.
10. REFERENCES - B. J. SNYDER AND G. L. GYOREY, CALCULATING GAMMA EFFICIENCIES IN SCINTILLATION DETECTORS, NUCLEONICS, VOL. 23, NO. 2, PP. 80-86, FEBRUARY 1965.
B. J. SNYDER, PH.D. THESIS, UNIVERSITY OF MICHIGAN, DEPARTMENT OF NUCLEAR ENGINEERING, 1965, APPENDIX E, INSTRUCTIONS FOR COMPUTER PROGRAMS FOR CALCULATION OF THE ABSOLUTE TOTAL EFFICIENCY AND PHOTOFRACTIONS.
B. J. SNYDER AND G. F. KNOLL, CALCULATED GAMMA RAY PHOTOFRACTIONS FOR WELL-TYPE SCINTILLATION DETECTORS, SUBMITTED TO NUCLEAR INSTRUMENTS AND METHODS, JUNE 1965.
11. MACHINE REQUIREMENTS - 32K IBM7090, 4 TAPES ON CHANNEL A, 4 TAPES ON CHANNEL B. CHANNEL A - 716 PRINTER (USING STANDARD SHARE II BOARD), 711 READER (USING NORMAL DIRECT READ BOARD). OPTIONAL ITEMS - RPQ M00680 (ADDRESSABLE STORAGE PROTECT), RPQ F89349 (CORE STORAGE CLOCK AND INTERVAL TIMER), ADDITIONAL TAPES. AS THE BINARY MASTER TAPES COME, BOTH RPQS ARE NEEDED. THE SHARE DISTRIBUTION CONTAINS NECESSARY INSTRUCTIONS AND PIECES FOR REASSEMBLY OF REQUIRED PARTS OF SYSTEM WHEN EITHER, OR BOTH, OF THESE RPQS ARE NOT AVAILABLE.
12. PROGRAMMING LANGUAGE USED - MAD (MICHIGAN ALGORITHM DECODER)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - MICHIGAN EXECUTIVE SYSTEM, AVAILABLE FROM DP PROGRAM INFORMATION DEPARTMENT, IBM CORPORATION, WHITE PLAINS, NEW YORK.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

REACTOR CODE ABSTRACT 165

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15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE -

SOURCE DECK (489 CARDS)
BINARY DECK (214 CARDS)
PROGRAM INSTRUCTIONS
REFERENCE REPORTS

17. CATEGORY - 0

KEYWORDS - EFFICIENCY, GAMMA RADIATION, CRYSTALS, SCINTILLATION
COUNTERS

1. NAME OR DESIGNATION OF PROGRAM - BURP3
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PROGRAM CALCULATES ABSOLUTE TOTAL EFFICIENCY FOR MONOENERGETIC GAMMA RAY INTERACTIONS IN CYLINDRICAL SCINTILLATION DETECTORS. THE ABSOLUTE TOTAL EFFICIENCY IS DEFINED AS THE FRACTION OF SOURCE GAMMAS WHICH INTERACT AT LEAST ONCE WITH THE CRYSTAL DETECTOR. CALCULATIONS ARE MADE FOR POINT ISOTROPIC SOURCES LOCATED BOTH ON AND OFF THE AXIS OF SYMMETRY FOR SOLID CYLINDRICAL CRYSTALS, WITH OR WITHOUT A COAXIAL CYLINDRICAL WELL. THE EFFICIENCIES FOR POINTS LOCATED AT SPECIFIED RADIAL OFF-AXIS POSITIONS, FOR A SINGLE AXIAL SOURCE-CRYSTAL DISTANCE, ARE NORMALIZED TO THE ON-AXIS EFFICIENCY FOR THE SAME AXIAL DISTANCE. THE ABSOLUTE EFFICIENCY FOR THE ON-AXIS POINT IS GIVEN.
4. METHOD OF SOLUTION - USES GAUSSIAN QUADRATURE NUMERICAL INTEGRATION TO EVALUATE INTEGRALS TO FOUR SIGNIFICANT FIGURES. WHEN REQUIRED, USES AITKENS FIFTH ORDER ITERATIVE FORMULA FOR INTERPOLATION OF CROSS SECTION DATA.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - CALCULATES FOR MONOENERGETIC NON-SYMMETRICALLY LOCATED POINT SOURCES IN THE ENERGY RANGE 0.01-30.0 MEV. NEGLECTS ANY MEDIA SURROUNDING THE CRYSTAL. FOR EACH RUN, THE CALCULATION FOR THE ON-AXIS POINT SOURCE IS GIVEN (REFERENCE BURP1 CODE), AND FOR UP TO 11 OFF-AXIS POINTS. ALL SOURCES MUST BE LOCATED WITHIN THE WELL FOR THE WELL-TYPE CRYSTAL, OR WITHIN THE CRYSTAL RADIUS FOR A CRYSTAL WITH NO WELL.
6. TYPICAL RUNNING TIME - (PER EFFICIENCY CALCULATION)
CRYSTAL WITH NO WELL - 0.1 SECOND
CRYSTAL WITH WELL - 0.5 SECOND
7. UNUSUAL FEATURES OF THE PROGRAM - ANY SIZE SCINTILLATION CRYSTAL OF MATERIAL WITH KNOWN TOTAL CROSS SECTIONS (WITHOUT COHERENT SCATTERING) MAY BE SPECIFIED. NAI TOTAL CROSS SECTIONS ARE STORED WITHIN THE PROGRAM. CALCULATIONS MAY BE MADE AT A PARTICULAR SOURCE ENERGY, OR OVER ANY DESIRED RANGE WITHIN THE ENERGIES 0.01-30.0 MEV. CALCULATIONS MAY BE MADE FOR A SINGLE SOURCE-CRYSTAL DISTANCE, OR A NUMBER OF DISTANCES.
8. RELATED AND AUXILIARY PROGRAMS -
 - (A) FOR ABSOLUTE TOTAL EFFICIENCIES -
 - (1) BURP1 (ACC ABSTRACT 164) ISOTROPIC POINT SOURCE ON AXIS OF SYMMETRY.
 - (2) BURP2 (ACC ABSTRACT 165) SYMMETRICALLY LOCATED ISOTROPIC DISK AND HOMOGENEOUS CYLINDRICAL VOLUME SOURCES (CAN INCLUDE SOURCE ABSORPTION AND SCATTERING).

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8. RELATED AND AUXILIARY PROGRAMS (CONTINUED)
 - (B) FOR PHOTOFRACTIONS -
 - (1) BURP4 (ACC ABSTRACT 169) CRYSTAL WITH NO WELL, ALL ISOTROPIC SOURCES AND COLLIMATED SOURCES.
 - (2) BURP5 (ACC ABSTRACT 170) WELL CRYSTAL, ALL ISOTROPIC SOURCES AND COLLIMATED SOURCES.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
IBM7090 VERSION SUBMITTED FEBRUARY 1965.
10. REFERENCES - B. J. SNYDER AND G. L. GYOREY, CALCULATING GAMMA EFFICIENCIES IN SCINTILLATION DETECTORS, NUCLEONICS, VOL. 23, NO. 2, PP. 80-86, FEBRUARY 1965.
B. J. SNYDER, PH.D. THESIS, UNIVERSITY OF MICHIGAN, DEPARTMENT OF NUCLEAR ENGINEERING, 1965, APPENDIX E, INSTRUCTIONS FOR COMPUTER PROGRAMS FOR CALCULATION OF THE ABSOLUTE TOTAL EFFICIENCY AND PHOTOFRACTIONS.
B. J. SNYDER AND G. F. KNOLL, CALCULATED GAMMA RAY PHOTOFRACTIONS FOR WELL-TYPE SCINTILLATION DETECTORS, SUBMITTED TO NUCLEAR INSTRUMENTS AND METHODS, JUNE 1965.
11. MACHINE REQUIREMENTS - 32K IBM7090, 4 TAPES ON CHANNEL A, 4 TAPES ON CHANNEL B. CHANNEL A - 716 PRINTER (USING STANDARD SHARE II BOARD), 711 READER (USING NORMAL DIRECT READ BOARD). OPTIONAL ITEMS - RPQ M00680 (ADDRESSABLE STORAGE PROTECT), RPQ F89349 (CORE STORAGE CLOCK AND INTERVAL TIMER), ADDITIONAL TAPES. AS THE BINARY MASTER TAPES COME, BOTH RPQS ARE NEEDED. THE SHARE DISTRIBUTION CONTAINS NECESSARY INSTRUCTIONS AND PIECES FOR REASSEMBLY OF REQUIRED PARTS OF SYSTEM WHEN EITHER, OR BOTH, OF THESE RPQS ARE NOT AVAILABLE.
12. PROGRAMMING LANGUAGE USED - MAD (MICHIGAN ALGORITHM DECODER)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - MICHIGAN EXECUTIVE SYSTEM, AVAILABLE FROM DP PROGRAM INFORMATION DEPARTMENT, IBM CORPORATION, WHITE PLAINS, NEW YORK.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE -
SOURCE DECK (231 CARDS)
BINARY DECK (105 CARDS)
PROGRAM INSTRUCTIONS
REFERENCE REPORTS

REACTOR CODE ABSTRACT 166

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17. CATEGORY - 0

KEYWORDS - EFFICIENCY, GAMMA RADIATION, CRYSTALS, SCINTILLATION
COUNTERS

REACTOR CODE ABSTRACT 167

10/67

1. NAME OR DESIGNATION OF PROGRAM - FLARE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635, CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - FLARE IS AN INEXPENSIVE CALCULATIONAL METHOD TO DETERMINE CORE REACTIVITY AND CORE POWER DISTRIBUTION. A SCOPING CALCULATION OF THIS TYPE IS VALUABLE IN APPRAISING THE PHYSICS CHARACTERISTICS OF PLANNED TEST MODES OF OPERATION SO THAT DETAILED ANALYSIS CAN BE RESERVED FOR THOSE CORE CALCULATIONS OF GREATER INTEREST FROM EITHER A TECHNICIAN OR SAFETY STANDPOINT.
4. METHOD OF SOLUTION - THE CALCULATIONS INCLUDE A REPRESENTATION OF THE COUPLED EFFECTS OF FLOW, POWER, VOIDS AND EACH CONTROL ROD INDEPENDENTLY.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - BECAUSE OF THE INDEPENDENT REPRESENTATION OF THE CONTROL RODS, A THREE-DIMENSIONAL CALCULATIONAL SCHEME WAS EMPLOYED. THIS THREE-DIMENSIONAL GEOMETRY COMBINED WITH COMPUTER SIZE LIMITATIONS RESTRICTED THE CALCULATIONS TO A RELATIVELY COARSE MESH. THE PRESENT VERSION OF THE CODE WILL HANDLE A MAXIMUM ARRAY OF 14 X 14 X 12 NODES WITH EITHER MIRROR OR DIAGONAL SYMMETRY.
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM - A 3-DIMENSIONAL COARSE-MESH FLUX CALCULATION IS INCORPORATED.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
PHILCD 2000 VERSION SUBMITTED FEBRUARY 1965, DELETED OCTOBER 1967.
GE635 VERSION SUBMITTED NOVEMBER 1966.
CDC3600 VERSION SUBMITTED DECEMBER 1966, SAMPLE PROBLEM EXECUTED BY ACC.
10. REFERENCES - D. L. DELP, D. L. FISHER, J. M. HARRIMAN, AND M. J. STEDWELL, FLARE - A THREE-DIMENSIONAL BOILING WATER REACTOR SIMULATOR, GEAP-4598, JULY 16, 1964.
NELS J. ANDERSON, JR., IDFTAP, A FORTRAN IV FUNCTION SUBPROGRAM, S6T001, JANUARY 15, 1965.
11. MACHINE REQUIREMENTS - 39K AND 3 TAPES IN ADDITION TO SYSTEM USE ON THE GE-635.
12. PROGRAMMING LANGUAGES USED - FORTRAN IV (GE635) AND FORTRAN 63 (CDC3600)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
GE635 GECOS AND CDC3600 SCOPE OPERATING SYSTEMS.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
PROGRAM USES TWO INTERMEDIATE TAPES AND PRODUCES A TAPE FOR OFF-
LINE PUNCHED CARDS.
15. NAME AND ESTABLISHMENT OF AUTHORS -
635 O. L. DELP AND O. L. FISHER, PHYSICS
J. M. HARRIMAN AND M. J. STEDWELL, PROGRAMMING
GENERAL ELECTRIC COMPANY
175 CURTNER AVENUE
SAN JOSE, CALIFORNIA
- 3600 S. ELKIN
NUCLEAR APPLICATIONS COMPUTATION CENTER
CONTROL DATA CORPORATION
COMPUTER DIVISION
3145 PORTER DRIVE
P. O. BOX 10111
PALO ALTO, CALIFORNIA 94303
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (635-3275 CARDS, 3600-2965 CARDS)
BINARY DECK (3600-696 CARDS)
SAMPLE PROBLEMS (635-53 CARDS, 3600-47 CARDS)
REFERENCE REPORTS
17. CATEGORY - C
KEYWORDS - REACTIVITY, POWER DISTRIBUTION, 3-DIMENSIONAL

REACTOR CODE ABSTRACT 168

10/67

1. NAME OR DESIGNATION OF PROGRAM - INVERSE KINETICS (R102)
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600, IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - GIVEN THE SPACE-INDEPENDENT, ONE ENERGY GROUP REACTOR KINETICS EQUATIONS AND THE INITIAL CONDITIONS, THIS PROGRAM DETERMINES THE TIME VARIATION OF REACTIVITY REQUIRED TO PRODUCE THE GIVEN INPUT OF FLUX-TIME DATA.
4. METHOD OF SOLUTION - TIME DERIVATIVES OF NEUTRON DENSITY ARE OBTAINED BY APPLICATION OF -
 - (1) FIVE-POINT QUARTIC,
 - (2) THREE-POINT PARABOLIC,
 - (3) FIVE-POINT LEAST-MEAN-SQUARE CUBIC,
 - (4) FIVE-POINT LEAST-MEAN-SQUARE PARABOLIC, OR
 - (5) FIVE-POINT LEAST-MEAN-SQUARE LINEAR
 FORMULAE TO THE NEUTRON DENSITY OR TO THE NATURAL LOGARITHM OF THE NEUTRON DENSITY. BETWEEN EACH DATA POINT THE NEUTRON DENSITY IS ASSUMED TO BE -
 - (1) EXPONENTIAL*(THIRD ORDER POLYNOMIAL),
 - (2) EXPONENTIAL, OR
 - (3) LINEAR.
 CHANGES IN REACTIVITY BETWEEN DATA POINTS ARE OBTAINED ALGEBRAICALLY FROM THE KINETICS EQUATIONS, NEUTRON DENSITY DERIVATIVES, AND THE ALGEBRAIC REPRESENTATION OF NEUTRON DENSITY. FIRST AND SECOND TIME DERIVATIVES OF THE REACTIVITY ARE OBTAINED BY USE OF ANY OF THE FORMULAE APPLICABLE TO THE NEUTRON DENSITY.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
 - 50 DELAY GROUPS
 - 1000 DATA POINTS
 - 99 DATA BLOCKS
 (A DATA BLOCK IS A SEQUENCE OF INPUT POINTS CHARACTERIZED BY A FIXED TIME INTERVAL BETWEEN POINTS, A SMOOTHING OPTION AND A NUMBER OF REPETITIONS OF THE SMOOTHING OPTION).
6. TYPICAL RUNNING TIME - USING SIX DELAY GROUPS, THE PROGRAM COMPUTES AND OUTPUTS APPROXIMATELY 30 POINTS PER SECOND (3600).
7. UNUSUAL FEATURES OF THE PROGRAM - THIS PROGRAM HAS BEEN USED FOR THE DETERMINATION OF FEEDBACK PARAMETERS, CONTROL ROD DESIGN AND EVALUATION OF CONTROL ROD WORTH. VARIOUS MODES OF SOLUTION ALLOW HIGH PRECISION WITH ANALYTIC DATA OR THE ANALYSIS OF DIGITALIZED DATA FROM RECORDING EQUIPMENT. SMOOTHING OF INPUT DATA MAY BE OBTAINED BY SINGLE OR REPEATED APPLICATION OF -
 - (1) FIVE-POINT CUBIC,
 - (2) FIVE-POINT PARABOLIC,

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)

(3) THREE-POINT LINEAR, OR

(4) FIVE-POINT LINEAR

LEAST-MEAN-SQUARE SMOOTHING FORMULAS. TABULAR OUTPUT INCLUDES EXCESS REACTIVITY, ITS FIRST AND SECOND DERIVATIVES, INPUT AND SMOOTHED INPUT DATA, INTEGRAL OF NEUTRON DENSITY, AND INSTANTANEOUS PERIOD. PRECURSOR DATA MAY BE INPUT OR OBTAINED FROM THE PROGRAM LIBRARY. STEADY-STATE INITIAL CONDITIONS MAY BE SPECIFIED BY INPUT OF A CONSTANT REACTIVITY OR PERIOD. NON-STEADY-STATE CONDITIONS REQUIRE PRECURSOR DENSITY INFORMATION. DISCONTINUOUS CHANGES IN REACTIVITY MAY BE GIVEN AS INPUT OR CALCULATED BY THE PROGRAM. ANY NUMBER OF RERUNS WITH VARYING SOLUTION MODES AND SMOOTHING OPTIONS MAY BE SCHEDULED.

8. RELATED AND AUXILIARY PROGRAMS - THIS PROGRAM SUPERCEDES RE138 AND RE171, ANL IBM704 PROGRAMS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC3600 VERSION SUBMITTED DECEMBER 1965, SAMPLE PROBLEM EXECUTED BY ACC.
IBM7094 VERSION SUBMITTED DECEMBER 1965.

10. REFERENCES - PRECURSOR LIBRARY IN PROGRAM IS FROM ANL-5800, SECOND EDITION, REACTOR PHYSICS CONSTANTS, JULY 1963.
J. J. KAGANOVE, ANL-AMD PROGRAM LIBRARY REPORT R102, JUNE 1965.
W-ANL NOTE - CHANGES MADE TO CONVERT R102+ TO FORTRAN IV.

11. MACHINE REQUIREMENTS - MINIMUM CDC3600.

12. PROGRAMMING LANGUAGES USED - FORTRAN 63 (3600)
FORTRAN IV (7094)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE (3600) AND IBSYS, VERSION 13 (7094).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -
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REACTOR CODE ABSTRACT 168

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16. MATERIAL AVAILABLE -
SOURCE DECKS (3600-752 CARDS, 7094-814 CARDS)
BINARY DECK (3600-403 CARDS)
SAMPLE PROBLEMS (3600-525 CARDS)
REFERENCE REPORT AND NOTE
17. CATEGORY - E
KEYWORDS - SPACE-INDEPENDENT KINETICS, REACTIVITY

1. NAME OR DESIGNATION OF PROGRAM - BURP4
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - BURP4 CALCULATES THE PHOTO-FRACTION FOR MONOENERGETIC GAMMA RAYS INTERACTING IN SOLID CYLINDRICAL SCINTILLATION DETECTORS. PHOTO-FRACTION IS DEFINED AS THE FRACTION OF INTERACTING SOURCE GAMMAS THAT ARE TOTALLY ABSORBED (INCLUDING SECONDARIES) IN THE CRYSTAL. ISOTROPIC SOURCE GEOMETRIES ALLOWED ARE ISOTROPIC POINTS (ON OR OFF-AXIS), DISKS, CYLINDRICAL VOLUMES. ALLOWED MONODIRECTIONAL SOURCES, NORMAL TO CRYSTAL FACE, ARE NARROW BEAM COLLIMATED TO CRYSTAL AXIS, BROAD BEAM ILLUMINATING ENTIRE CRYSTAL FACE, AND COLLIMATED BEAM OF ANY SPECIFIED DIAMETER.
4. METHOD OF SOLUTION - USES MONTE CARLO METHODS TO SIMULATE TRANSPORT OF GAMMAS, AND SECONDARIES (ELECTRONS AND BREMSSTRAHLUNG).
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - SOURCE ENERGY RANGE MUST BE 0.01-30 MEV. SOLID CYLINDRICAL CRYSTALS ONLY.
6. TYPICAL RUNNING TIME - 4 MEV SOURCE ENERGY (2000 PRIMARY INTER-ACTIONS) - APPROXIMATELY 3 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - ESCAPE OF ELECTRONS GENERATED BY PRIMARY GAMMA PROCESSES IS DETERMINED BY SAMPLING FROM TRANSMISSION DATA. BREMSSTRAHLUNG PHOTONS ARE GENERATED AND FOLLOWED THROUGH MEDIUM. ELECTRON TRANSMISSION DATA AND BREMSSTRAHLUNG SPECTRA DATA INCLUDED IN PROGRAM FOR NA1, AND ABOVE APPROXIMATELY 3 MEV, SOME ERROR IS INTRODUCED IF CALCULATION IS MADE FOR MATERIAL OTHER THAN NA1. GAMMA RAY CROSS SECTIONS FOR NA1 ARE INCLUDED IN PROGRAM, BUT OTHER CROSS SECTION DATA MAY BE READ FOR DIFFERENT SCINTILLATION MATERIALS.
8. RELATED AND AUXILIARY PROGRAMS -
 - (A) FOR ABSOLUTE TOTAL EFFICIENCIES -
 - (1) BURP1 ISOTROPIC POINT SOURCE ON AXIS OF SYMMETRY.
 - (2) BURP2 SYMETRICALLY LOCATED ISOTROPIC DISK AND HOMOGENEOUS CYLINDRICAL VOLUME SOURCES (CAN INCLUDE SOURCE ABSORPTION AND SCATTERING).
 - (3) BURP3 ISOTROPIC POINT SOURCE LOCATED OFF AXIS OF SYMMETRY.
 - (B) FOR PHOTO-FRACTIONS -
 - (1) BURP5 WELL CRYSTAL, ALL ISOTROPIC SOURCES AND COLLIMATED SOURCES.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7090 VERSION SUBMITTED DECEMBER 1965.

10. REFERENCES - B. J. SNYDER AND G. L. GYOREY, CALCULATING GAMMA EFFICIENCIES IN SCINTILLATION DETECTORS, NUCLEONICS, VOL. 23, NO. 2, PP. 80-86, FEBRUARY 1965.
B. J. SNYDER, PH.D. THESIS, UNIVERSITY OF MICHIGAN, DEPARTMENT OF NUCLEAR ENGINEERING, 1965, APPENDIX E, INSTRUCTIONS FOR COMPUTER PROGRAMS FOR CALCULATION OF THE ABSOLUTE TOTAL EFFICIENCY AND PHOTOFRACTIONS.
B. J. SNYDER AND G. F. KNOLL, CALCULATED GAMMA RAY PHOTOFRACTIONS FOR WELL-TYPE SCINTILLATION DETECTORS, SUBMITTED TO NUCLEAR INSTRUMENTS AND METHODS, JUNE 1965.
11. MACHINE REQUIREMENTS - 32K IBM7090, 4 TAPES ON CHANNEL A, 4 TAPES ON CHANNEL B. CHANNEL A - 716 PRINTER (USING STANDARD SHARE II BOARD), 711 READER (USING NORMAL DIRECT READ BOARD). OPTIONAL ITEMS - RPO M00680 (ADDRESSABLE STORAGE PROTECT), RPO F89349 (CORE STORAGE CLOCK AND INTERVAL TIMER), ADDITIONAL TAPES. AS THE BINARY MASTER TAPES COME, BOTH RPOs ARE NEEDED. THE SHARE DISTRIBUTION CONTAINS NECESSARY INSTRUCTIONS AND PIECES FOR REASSEMBLY OF REQUIRED PARTS OF SYSTEM WHEN EITHER, OR BOTH, OF THESE RPOs ARE NOT AVAILABLE.
12. PROGRAMMING LANGUAGE USED - MAD (MICHIGAN ALGORITHM DECODER)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - MICHIGAN EXECUTIVE SYSTEM, AVAILABLE FROM DP PROGRAM INFORMATION DEPARTMENT, IBM CORPORATION, WHITE PLAINS, NEW YORK.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
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16. MATERIAL AVAILABLE -
SOURCE DECK (872 CARDS)
BINARY DECK (279 CARDS)
REFERENCE REPORTS
17. CATEGORY - D
KEYWORDS - GAMMA RADIATION, CRYSTALS, SCINTILLATION COUNTERS

1. NAME OR DESIGNATION OF PROGRAM - BURPS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - BURPS CALCULATES THE PHOTO-FRACTION FOR MONOENERGETIC GAMMA RAYS INTERACTING IN WELL-TYPE CYLINDRICAL SCINTILLATION DETECTORS. PHOTO-FRACTION IS DEFINED AS THE FRACTION OF INTERACTING SOURCE GAMMAS THAT ARE TOTALLY ABSORBED (INCLUDING SECONDARIES) IN THE CRYSTAL. ISOTROPIC SOURCE GEOMETRIES ALLOWED ARE ISOTROPIC POINTS (ON OR OFF-AXIS), DISKS, CYLINDRICAL VOLUMES. ALSO ALLOWS NARROW MONODIRECTIONAL BEAM COLLIMATED TO CRYSTAL AXIS, INCIDENT NORMAL TO WELL BOTTOM.
4. METHOD OF SOLUTION - USES MONTE CARLO METHODS TO SIMULATE TRANSPORT OF GAMMAS, AND SECONDARIES (ELECTRONS AND BREMSSTRAHLUNG).
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - SOURCE ENERGY RANGE MUST BE 0.01-30 MEV. WELL-TYPE CYLINDRICAL CRYSTALS ONLY.
6. TYPICAL RUNNING TIME - 4 MEV SOURCE ENERGY (2000 PRIMARY INTERACTIONS) - APPROXIMATELY 4.5 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - ESCAPE OF ELECTRONS GENERATED BY PRIMARY GAMMA PROCESSES IS DETERMINED BY SAMPLING FROM TRANSMISSION DATA. BREMSSTRAHLUNG PHOTONS ARE GENERATED AND FOLLOWED THROUGH MEDIUM. ELECTRON TRANSMISSION DATA AND BREMSSTRAHLUNG SPECTRA DATA INCLUDED IN PROGRAM FOR NAI, AND ABOVE APPROXIMATELY 1 MEV, SOME ERROR IS INTRODUCED IF CALCULATION IS MADE FOR MATERIAL OTHER THAN NAI. GAMMA RAY CROSS SECTIONS FOR NAI ARE INCLUDED IN PROGRAM, BUT OTHER CROSS SECTION DATA MAY BE READ FOR DIFFERENT SCINTILLATION MATERIALS.
8. RELATED AND AUXILIARY PROGRAMS -
 - (A) FOR ABSOLUTE TOTAL EFFICIENCIES -
 - (1) BURP1 ISOTROPIC POINT SOURCE ON AXIS OF SYMMETRY.
 - (2) BURP2 SYMMETRICALLY LOCATED ISOTROPIC DISK AND HOMOGENEOUS CYLINDRICAL VOLUME SOURCES (CAN INCLUDE SOURCE ABSORPTION AND SCATTERING).
 - (3) BURP3 ISOTROPIC POINT SOURCE LOCATED OFF AXIS OF SYMMETRY.
 - (B) FOR PHOTO-FRACTIONS -
 - (1) BURP4 SOLID CRYSTAL, ALL ISOTROPIC SOURCES AND COLLIMATED SOURCES.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7090 VERSION SUBMITTED DECEMBER 1965.

10. REFERENCES - B. J. SNYDER AND G. L. GYOREY, CALCULATING GAMMA EFFICIENCIES IN SCINTILLATION DETECTORS, NUCLEONICS, VOL. 23, NO. 2, PP. 80-86, FEBRUARY 1965.
B. J. SNYDER, PH.D. THESIS, UNIVERSITY OF MICHIGAN, DEPARTMENT OF NUCLEAR ENGINEERING, 1965, APPENDIX E, INSTRUCTIONS FOR COMPUTER PROGRAMS FOR CALCULATION OF THE ABSOLUTE TOTAL EFFICIENCY AND PHOTOFRACTIONS.
B. J. SNYDER AND G. F. KNOLL, CALCULATED GAMMA RAY PHOTOFRACTIONS FOR WELL-TYPE SCINTILLATION DETECTORS, SUBMITTED TO NUCLEAR INSTRUMENTS AND METHODS, JUNE 1965.
11. MACHINE REQUIREMENTS - 32K IBM7090, 4 TAPES ON CHANNEL A, 4 TAPES ON CHANNEL B. CHANNEL A - 716 PRINTER (USING STANDARD SHARE II BOARD), 711 READER (USING NORMAL DIRECT READ BOARD). OPTIONAL ITEMS - RPQ M00680 (ADDRESSABLE STORAGE PROTECT), RPQ F89349 (CORE STORAGE CLOCK AND INTERVAL TIMER), ADDITIONAL TAPES. AS THE BINARY MASTER TAPES COME, BOTH RPQS ARE NEEDED. THE SHARE DISTRIBUTION CONTAINS NECESSARY INSTRUCTIONS AND PIECES FOR REASSEMBLY OF REQUIRED PARTS OF SYSTEM WHEN EITHER, OR BOTH, OF THESE RPQS ARE NOT AVAILABLE.
12. PROGRAMMING LANGUAGE USED - MAD (MICHIGAN ALGORITHM DECODER)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - MICHIGAN EXECUTIVE SYSTEM, AVAILABLE FROM OP PROGRAM INFORMATION DEPARTMENT, IBM CORPORATION, WHITE PLAINS, NEW YORK.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
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WESTINGHOUSE ELECTRIC CORPORATION
ASTRONUCLEAR LABORATORY
P. O. BOX 10864
PITTSBURGH, PENNSYLVANIA 15236
16. MATERIAL AVAILABLE -
SOURCE DECK (1211 CARDS)
BINARY DECK (343 CARDS)
REFERENCE REPORTS
17. CATEGORY - 0
KEYWORDS - GAMMA RADIATION, CRYSTALS, SCINTILLATION COUNTERS

1. NAME OR DESIGNATION OF PROGRAM - NEARREX
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - NEARREX COMPUTES NEUTRON-INDUCED, AVERAGE FLUCTUATION (OR COMPOUND NUCLEUS) CROSS SECTIONS. PROVISION IS MADE FOR THE COMPUTATION OF COMPOUND ELASTIC AND INELASTIC NEUTRON CROSS SECTIONS, RADIATIVE CAPTURE AND FISSION CROSS SECTIONS, AS WELL AS OTHER PROCESSES, SUCH AS PROTON EMISSION. IT CAN ALSO BE USED TO COMPUTE PROTON-INDUCED AVERAGE CROSS SECTIONS.
4. METHOD OF SOLUTION - AT EACH INCIDENT NEUTRON ENERGY E , A NEUTRON PARTIAL WAVE CHANNEL IS SPECIFIED BY ITS ORBITAL ANGULAR-MOMENTUM QUANTUM NUMBER, L , BY THE TOTAL NEUTRON ANGULAR MOMENTUM, $J = L + (I - 1/2)$, BY THE TOTAL ANGULAR MOMENTUM, J , AND BY THE RESIDUAL STATE OF THE TARGET NUCLEUS. THESE RESIDUAL STATES CAN BE ANY ONE OF THE GROUND OR EXCITED STATES OF THE TARGET NUCLEUS, FOR WHICH EXCITATION ENERGIES, SPINS, AND PARITIES (II) MUST BE SPECIFIED. THE AVERAGE RESONANCE PARAMETERS FOR EACH OF THESE NEUTRON CHANNELS ARE COMPUTED AS A FUNCTION OF THE COMPOUND TRANSMISSION COEFFICIENTS, SPECIFIED AS INPUT. THE LATTER WILL USUALLY BE OBTAINED FROM AN OPTICAL MODEL CALCULATION. THE AVERAGE RESONANCE PARAMETERS FOR RADIATION CHANNELS ARE COMPUTED USING VARIOUS APPROXIMATIONS. THE PARAMETER Σ CAN BE GIVEN THE VALUES 2, 4, 6, 8, OR 10. SETTING Σ EQUALS 0 OR 12 RESULTS IN F IDENTICALLY EQUAL TO 1, OR F IDENTICALLY EQUAL TO $2J+1$, RESPECTIVELY. THE LUMPED RESONANCE PARAMETERS FOR EACH J, II ARE ASSUMED TO BE INDEPENDENT OF THE RESONANCE INDICES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE STATISTICAL PARAMETER, $Q(\alpha)$, MUST BE SPECIFIED TO HAVE THE SAME VALUE FOR ALL CHANNELS IN THIS PROGRAM. FOR THIS REASON, IT IS IN GENERAL ONLY SAFE TO SPECIFY Q VALUES BETWEEN 0 AND 1. EACH NEUTRON PARTIAL WAVE IS ASSUMED TO BE DISTRIBUTED ACCORDING TO THE CHI-SQUARE DISTRIBUTION WITH ONE DEGREE OF FREEDOM (PORTER-THOMAS).
6. TYPICAL RUNNING TIME - $0.04NE(N_{MAX}+1)(2L_{MAX}+1)$ MINUTES FOR THE IBM704. CDC3600 SHOULD BE ABOUT 8 TO 10 TIMES FASTER FOR LARGE PROBLEMS. NE =NUMBER OF INCIDENT NEUTRON ENERGIES. N_{MAX} =NUMBER OF EXCITED LEVELS OF TARGET NUCLEUS. L_{MAX} =MAXIMUM L -VALUE USED FOR TRANSMISSION COEFFICIENTS.
7. UNUSUAL FEATURES OF THE PROGRAM - THE INPUT FORMAT FOR THE ELASTIC AND INELASTIC $T(\alpha, COMP)$ IS THE SAME AS THE FORMAT OF THE TRANSMISSION COEFFICIENTS THAT CAN BE PUNCHED FROM THE ABACUS2 OPTICAL MODE CODE. HOWEVER, THE NUMBER OF TRANSMISSION

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7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
COEFFICIENTS PUNCHED BY ABACUS 2 WILL USUALLY NOT COINCIDE WITH THE NUMBER REQUIRED IN THE INPUT OF NEARREX.
8. RELATED AND AUXILIARY PROGRAMS - ABACUS2 PRODUCES TRANSMISSION COEFFICIENTS THAT CAN BE USED BY NEARREX.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC3600 VERSION SUBMITTED AUGUST 1965, SAMPLE PROBLEM EXECUTED BY ACC.
10. REFERENCE - P. A. MOLDAUER, C. A. ENGELBRECHT, AND G. J. DUFFY, NEARREX, A COMPUTER CODE FOR NUCLEAR REACTION CALCULATIONS, ANL-6978, DECEMBER 1964.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN 63 (CDC3600)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE (CDC3600).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
P. A. MOLDAUER, REACTOR PHYSICS DIVISION
G. J. DUFFY, APPLIED MATHEMATICS DIVISION
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439

C. A. ENGELBRECHT
SOUTH AFRICAN ATOMIC ENERGY BOARD
PRIVATE BAG 256
PELINDABA, PRETORIA, SOUTH AFRICA
16. MATERIAL AVAILABLE -
SOURCE DECK (1041 CARDS)
BINARY DECK (400 CARDS)
SAMPLE PROBLEM (19 CARDS)
REFERENCE REPORT
17. CATEGORY - A
KEYWORDS - COMPOUND NUCLEUS, CROSS SECTIONS, ELASTIC SCATTERING, INELASTIC SCATTERING, CAPTURE, FISSION

1. NAME OR DESIGNATION OF PROGRAM - AISITE2/R153
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094, CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - AISITE2 IS LARGELY BASED ON METHODS PROPOSED BY THE AEC IN TID-14844 BUT DIFFERS IN CERTAIN OF THE ASSUMPTIONS AND MODELS. THE CODE AUTOMATICALLY VARIES ANY ONE OF 46 PARAMETERS SUCH AS REACTOR POWER, BUILDING LEAK RATE, IODINE CLEAN-UP RATE, AND HALOGEN FILTER EFFICIENCY, COMPUTING THE EXCLUSION AREA, AND LOW POPULATION BOUNDARY ZONES AS FUNCTIONS OF THAT PARAMETER. THE EDIT INCLUDES DOSE VS. DISTANCE DATA, FRACTIONAL CONTRIBUTION BY ISOTOPE GROUP TO THE INHALATION DOSE, AND CRITICAL DISTANCES PROVIDING BOTH PRINTED AND GRAPHICAL DATA. THREE MODELS ARE AVAILABLE FOR FISSION PRODUCT RELEASE WITH UP TO 4 LEVELS OF CONTAINMENT.
4. METHOD OF SOLUTION - ANALYTIC SOLUTIONS TO THE DIFFERENTIAL EQUATIONS ARE EVALUATED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
100 ISOTOPES
20 DISTANCES
10 VALUES OF VARIABLE PARAMETER
8 ORGANS
4 LEVELS OF CONTAINMENT
6. TYPICAL RUNNING TIME - ONE CASE WITH 10 DISTANCES AND 10 VALUES OF THE VARIABLE PARAMETER REQUIRES ABOUT 20 SECONDS FOR BOTH PRINTED AND GRAPHICAL OUTPUT.
7. UNUSUAL FEATURES OF THE PROGRAM - AISITE2 HAS BEEN OPTIMIZED TO REDUCE RUNNING TIME BY KEEPING TRACK OF THOSE PORTIONS OF THE CALCULATION WHICH NEED NOT BE RE-EVALUATED, I.E., ARE NOT AFFECTED BY THE VARIABLE PARAMETER. THIS OPTIMIZATION RESULTED IN UP TO A FACTOR OF 10 SAVINGS OVER THE EARLIER VERSION OF THE CODE.
8. RELATED AND AUXILIARY PROGRAMS - THIS PROGRAM IS A LATER VERSION OF THE PROGRAM, AISITE (NAA-SR-MEMO-9235).
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7094 VERSION SUBMITTED APRIL 1965.
CDC3600 VERSION SUBMITTED OCTOBER 1965.
10. REFERENCES - R. A. BLAINE AND E. L. BRAMBLETT, AISITE II, A DIGITAL COMPUTER PROGRAM FOR INVESTIGATION OF REACTOR SITING, NAA-SR-9982, SEPTEMBER 1964.
M. HOFFMAN AND W. A. RHOADES, AICRT3, A GENERAL CODE FOR DISPLAY OF DIGITAL DATA, NAA-SR-MEMO 9069, OCTOBER 1963.
D. H. LOVEGROVE, ANL-AMD PROGRAM LIBRARY REPORT R153, OCTOBER 1965, AND MODIFICATIONS.

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11. MACHINE REQUIREMENTS - 32K IBM7094 WITH SC-4020 GRAPHICAL DISPLAY DEVICE.
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP (IBM), FORTRAN 63 (CDC)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN MONITOR (7090) AND SCOPE (3600).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - IF AN SC-4020 GRAPHICAL DISPLAY DEVICE IS NOT AVAILABLE, DUMMY ROUTINES CAN BE USED FOR SUBROUTINES GRAPH AND AICRT3, OR THESE ROUTINES CAN BE REWRITTEN. THE NAA SC-4020 SUBROUTINE PACKAGE IS AVAILABLE THROUGH -

UNIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA

15. NAME AND ESTABLISHMENT OF AUTHORS -

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MODIFIED FOR THE CDC3600 BY

D. LOVEGROVE
APPLIED MATHEMATICS DIVISION, BUILDING 221
ARGONNE NATIONAL LABORATORY
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ARGONNE, ILLINOIS 60439

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7094-2413 CARDS AND 3600-1781 CARDS)
BINARY DECK (3600-181 CARDS)
SAMPLE PROBLEMS (7094-99 CARDS, 3600-100 CARDS)
REFERENCE REPORTS
17. CATEGORY - G
KEYWORDS - DOSE RATES, DISTANCE, CONTAINMENT, FISSION PRODUCTS

1. NAME OR DESIGNATION OF PROGRAM - 2DF
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604A
3. NATURE OF PHYSICAL PROBLEM SOLVED - 2DF IS A TWO-DIMENSIONAL MULTIGROUP PROGRAM WRITTEN IN FORTRAN FOR SOLVING THE NEUTRON TRANSPORT EQUATION USING THE SN METHOD. THE PROGRAM CAN DETERMINE THE REAL OR ADJOINT SOLUTION FOR X-Y, R-Z, OR R-THETA GEOMETRY. ISOTROPIC OR A FORM OF LINEAR ANISOTROPIC SCATTERING MAY BE CONSIDERED. VARIOUS BOUNDARY CONDITIONS ARE ALLOWED. THE PROGRAM ALSO CONTAINS A NUMBER OF SEARCH OPTIONS WHEREBY ONE CAN VARY DIMENSIONS OR CONCENTRATIONS TO ARRIVE AT A PREDETERMINED EIGENVALUE. A DISTRIBUTED SOURCE MAY BE SPECIFIED. A LIBRARY OF CROSS SECTIONS IS AVAILABLE ON MAGNETIC TAPE. CROSS SECTIONS MAY BE READ FROM THE LIBRARY TAPE AND/OR FROM CARDS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM. - STORAGE RESTRICTIONS ARE SPECIFIED BY A COMPLICATED EQUATION INVOLVING $S(N)$ ORDER, NUMBER OF MATERIALS, MESH INTERVALS, AND ENERGY GROUPS, AND SPECIFIED BOUNDARY CONDITIONS.
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - 2DF IS A TWO-DIMENSIONAL VERSION OF THE DTF PROGRAM (ACC ABSTRACT 144).
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JANUARY 1966.
10. REFERENCES - UNITED NUCLEAR CORPORATION NOTES ON 2DF INPUT DATA DECK ARRANGEMENT, 2DF PROBLEM DECK ARRANGEMENT, OPERATING INSTRUCTIONS, 2DF INPUT FORMS.
2DF CROSS SECTION INPUT, PHYS/MATH MEMO 3816, OCTOBER 23, 1964.
MAXIMUM SIZE 2DF PROBLEM, PHYS/MATH MEMO 3703, SEPTEMBER 9, 1964.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - COOP MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

REACTOR CODE ABSTRACT 173

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15. NAME AND ESTABLISHMENT OF AUTHOR -

MARTIN SHAPIRO
UNITED NUCLEAR CORPORATION
WHITE PLAINS, NEW YORK

16. MATERIAL AVAILABLE -

SOURCE DECK (2590 CARDS)
REFERENCE NOTES AND INTER-OFFICE MEMORANDA

17. CATEGORY - C

KEYWORDS - SN METHOD, 2-DIMENSIONAL, MULTIGROUP, X-Y, R-Z, R-
THETA, CRITICALITY SEARCHES, ANISOTROPIC SCATTERING

1. NAME OR DESIGNATION OF PROGRAM - FORE/FORE2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - PHILCO-2000, GE635
3. NATURE OF PHYSICAL PROBLEM SOLVED - FORE CALCULATES REACTOR POWER AND TEMPERATURES OF FUEL, COOLANT, CLAD, AND STRUCTURE AS FUNCTIONS OF TIME IN RESPONSE TO A PROGRAMMED REACTIVITY INSERTION SPECIFIED AS A SERIES OF RAMPS. TEMPERATURE PROFILES ARE COMPUTED AT SPECIFIED AXIAL POSITIONS FOR AN AVERAGE CHANNEL AND FOR THE PEAK POWER (CENTRAL) CHANNEL. THE HEAT OF FUSION ACCOMPANYING FUEL MELTING IS TAKEN INTO ACCOUNT. FEEDBACK REACTIVITY MECHANISMS THAT RESPOND TO CHANGES OF TEMPERATURES INCLUDE THE FUEL DOPPLER EFFECT AND THERMAL EXPANSION OF THE CORE (AND AXIAL BLANKET OR REFLECTOR) MATERIALS. FORE2 IS A COUPLED THERMAL HYDRAULICS-POINT KINETICS DIGITAL COMPUTER CODE DESIGNED TO CALCULATE SIGNIFICANT REACTOR PARAMETERS UNDER STEADY-STATE CONDITIONS, OR AS FUNCTIONS OF TIME DURING TRANSIENTS. THE TRANSIENTS MAY RESULT FROM A PROGRAMMED REACTIVITY INSERTION OR A POWER CHANGE. VARIABLE INLET COOLANT FLOW RATE AND TEMPERATURE ARE CONSIDERED. THE CODE CALCULATES THE REACTOR POWER, THE INDIVIDUAL REACTIVITY FEEDBACKS, AND THE TEMPERATURE OF COOLANT, CLADDING, FUEL, STRUCTURE, AND ADDITIONAL MATERIAL FOR UP TO SEVEN AXIAL POSITIONS IN THREE CHANNEL TYPES WHICH REPRESENT RADIAL ZONES OF THE REACTOR. THE HEAT OF FUSION ACCOMPANYING FUEL MELTING, THE LIQUID METAL VOIDING REACTIVITY, AND THE SPATIAL AND THE TIME VARIATION OF THE FUEL CLADDING GAP COEFFICIENT DUE TO CHANGES IN GAP SIZE ARE CONSIDERED.
4. METHOD OF SOLUTION - FORE2 INPUT CONSISTS OF PROPERTY DATA, GEOMETRY, POWER AND FLOW DISTRIBUTION FACTORS, EXTERNAL TIME VARYING FUNCTIONS, EXPERIMENTAL COEFFICIENTS, AND TERMINATION DATA. THE DIFFERENTIAL EQUATIONS FOR FLUID FLOW, HEAT TRANSFER, AND POINT NEUTRONICS ARE SOLVED BY EXPLICIT FINITE-DIFFERENCE PROCEDURES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - REACTOR EXCURSIONS WHICH CAN BE CALCULATED ARE RESTRICTED TO THOSE TRANSIENTS IN WHICH THE REACTOR IS NOT SUBSTANTIALLY DESTROYED. AS A GENERAL RULE, CHANGES IN REACTOR GEOMETRY AND COMPOSITION DURING AN EXCURSION ARE LIMITED TO THOSE CASES IN WHICH THE REACTIVITY EFFECTS OF THE CHANGES MAY BE CONSIDERED AS SMALL PERTURBATIONS OF THE INITIAL SYSTEM. THUS, ACCIDENTS INVOLVING LARGE-SCALE DISASSEMBLY AND BULK MELTDOWN OF A CORE ARE NOT COVERED BY FORE OR FORE2. UP TO SIX DELAYED NEUTRON GROUPS MAY BE USED IN FORE. FORE2 IS VALID ONLY WHILE THE CORE RETAINS ITS INITIAL GEOMETRY.
6. TYPICAL RUNNING TIME - RUNNING TIME OF FORE IS PROPORTIONAL TO THE NUMBER OF TIME-STEPS, GENERALLY 2 TO 26 MINUTES. ON A 10 MICRO-SECOND COMPUTER FORE2 RUNNING TIME IS ON THE ORDER OF 3.5 SECONDS PER STEP, FOR A 1 MICROSECOND COMPUTER 0.5 SECOND PER STEP.

7. UNUSUAL FEATURES OF THE PROGRAM - UNUSUAL FEATURES OF FORE2 INCLUDE -
 - (A) VARIABLE CLAD-FUEL GAP COEFFICIENT MODEL.
 - (B) SIMULATION OF LIQUID METAL VOIDING.
 - (C) UNLIMITED WRAPUP AND RESTART CAPABILITY WITH CHANGES IN INPUT PERMITTED BEFORE RESTART.
 - (D) DETERMINATION OF MAXIMUM STABLE TIME-STEP BY CODE.
 - (E) SEPARATION OF POWER INTO PROMPT AND TOTAL (INCLUDES DECAY HEAT).
 - (F) CAPABILITY TO USE ANY SINGLE PHASE COOLANT.
 - (G) INCLUSION OF FUEL BOWING AND CORE DEFORMATION DUE TO AXIAL PRESSURE DIFFERENCE.
 - (H) ABILITY TO HANDLE CORRECTLY THE VARIATION OF COOLANT FLOW RATE IN CHANNELS WITH ORIFICING DURING A COASTDOWN ACCIDENT.
8. RELATED AND AUXILIARY PROGRAMS - THE FORE PROGRAM CONSISTS OF THE MAIN PROGRAM FORE WHICH HANDLES BOOKKEEPING, ERROR CHECKING, AND RESTARTING AND SEVEN SUBROUTINES - INPUT, INIT, POWT, COPH, FEED, TERM, AND OUTPUT. FORE2 CONSISTS OF THREE INDEPENDENT CODES -
 - (A) EEEE PERFORMS ALL CALCULATIONS AND GIVES A CONDENSED OR SHORT EDIT OF THE RESULTS.
 - (B) FEDIT GIVES A DETAILED OR LONG EDIT OF THE RESULTS.
 - (C) FRCURV PERFORMS CURVE PLOTTING OF THE OUTPUT.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
 FORE, PHILCO-2000 VERSION, SUBMITTED NOVEMBER 1965.
 FORE2, GE635 VERSION, SUBMITTED JULY 1967.
10. REFERENCES - P. GREEBLER, D. B. SHERER, N. H. WALTON, FORE, A COMPUTATIONAL PROGRAM FOR THE ANALYSIS OF FAST REACTOR EXCURSIONS, GEAP-4090, OCTOBER 16, 1962, PLUS ERRATA AND ADDENDA, EA2, FEBRUARY 10, 1965, EA3, JUNE 22, 1965, AND EA4, DECEMBER 22, 1965.
 J. N. FOX, B. E. LAWLER, AND H. R. BUTZ, FORE II, A COMPUTATIONAL PROGRAM FOR THE ANALYSIS OF STEADY-STATE AND TRANSIENT REACTOR PERFORMANCE, GEAP-5273, SEPTEMBER 1966.
 FORE2 SUBROUTINE DESCRIPTIONS INCLUDING -
 NELS J. ANDERSON, JR., IDFTAP, A FORTRAN IV FUNCTION SUBPROGRAM, S6T001, JANUARY 15, 1965.
 BITA, L5T001, DECEMBER 3, 1964.
 NELS J. ANDERSON, JR., FORTRAN IV SUBROUTINE ERRSYS, S4T001, JANUARY 15, 1965.
 FLEXO, J3T001, JANUARY 21, 1965.
 FLTBCD, L2T006.
 LISTFORM, S6T002, FEBRUARY 12, 1964.
 NFXBCD, L2T004, NOVEMBER 16, 1965.
 C. T. EHLERS, NSORT, P5T001, OCTOBER 29, 1964.
 JOHN W. WEIL, PLOTFC, K5T003.
 WALTER A. DUNCAN, VAMPIR, K5F009, APRIL 25, 1966.
 A. E. SCADDEN, ZERO, DIVISION OVERFLOW MODIFIER, Q4T001.

11. MACHINE REQUIREMENTS - 32K MEMORY (FORE), 3 FILES AND 40K MEMORY (FORE2)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SMART, THE GE-APED MONITOR, AND GECOS.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - FORE REQUIRES AS INPUT A MINIMUM AND MAXIMUM STEP-SIZE WHICH WILL PLACE A LIMIT ON THE DOUBLING OR HALVING PROCESS, AND AN INITIAL STEP-SIZE WITH WHICH TO BEGIN THE CALCULATION. FORE2 CALLS SEVERAL SYSTEMS SUBROUTINES WHICH ARE NOT INCLUDED WITH THE PROGRAM. HOWEVER, WRITEUPS OF THESE SUBROUTINES ARE INCLUDED WITH THE CODE PACKAGE.
15. NAME AND ESTABLISHMENT OF AUTHORS -
FORE P. GREEBLER, D. B. SHERER AND N. H. WALTON
ATOMIC POWER EQUIPMENT DEPARTMENT
GENERAL ELECTRIC COMPANY
SAN JOSE, CALIFORNIA

FORE2 J. N. FOX, B. E. LAWLER, AND H. R. BUTZ
ADVANCED PRODUCTS OPERATION
GENERAL ELECTRIC COMPANY
SUNNYVALE, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (FORE 2000-2687 CARDS, FORE2 635-8763 CARDS,
FEDIT 635-1148 CARDS, FRCURV 635-2305 CARDS)
SAMPLE PROBLEMS (FORE 2000-61 CARDS, FORE2 635-139 CARDS)
REFERENCE REPORTS, ERRATA AND ADDENDA, FORE2 SUBROUTINE
DESCRIPTIONS
17. CATEGORY - F
KEYWORDS - EXCURSIONS, POWER DISTRIBUTION, TEMPERATURE, FEEDBACK,
KINETICS, FUELS, COOLANTS, FLUID FLOW, HEAT TRANSFER,
EEEE CODES, FEDIT CODES, FRCURV CODES

1. NAME OR DESIGNATION OF PROGRAM - RAPTURE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - PHILCO-2000
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS CODE COMPUTES RESONANCE INTEGRALS, AVERAGES THEM OVER RESONANCE PARAMETRIC DISTRIBUTIONS, AND COMPUTES FISSION AND CAPTURE CROSS SECTIONS AS A FUNCTION OF FUEL TEMPERATURE AND OF POTENTIAL SCATTERING CROSS SECTION PER ABSORBER ISOTOPE.
4. METHOD OF SOLUTION - THE CROSS SECTIONS ARE COMPUTED AT SPECIFIED VALUES OF NEUTRON ENERGY FOR THE UNRESOLVED RESONANCE REGION AND THEY ARE COMPUTED SEPARATELY FOR EACH ANGULAR MOMENTUM STATE (L,J) OF A GIVEN COMPOUND NUCLEUS. FOR THE RESOLVED RESONANCE REGION OF A GIVEN ISOTOPE, FISSION AND CAPTURE CROSS SECTIONS ARE FLUX-AVERAGED OVER A SPECIFIED ENERGY INTERVAL.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE CALCULATIONS ARE STRICTLY VALID ONLY FOR THE ENERGY RANGE IN WHICH RESONANCES ARE WELL-SEPARATED (LESS THAN 1 KEV FOR U235 AND PU239, LESS THAN 10 KEV FOR U238). AT HIGHER ENERGIES THE CODES MAY BE USED FOR DOPPLER CALCULATIONS WITH A RELATIVELY SMALL CORRECTION OF THE OUTPUT REQUIRED FOR RESONANCE OVERLAP.
6. TYPICAL RUNNING TIME - THREE SECONDS PER RESONANCE IN THE RESOLVED RESONANCE REGION. FOR THE UNRESOLVED RESONANCE REGION, THE MAXIMUM TIME FOR FISSIONABLE ISOTOPE IS 2 MINUTES PER ENERGY POINT FOR ONE ANGULAR MOMENTUM STATE (L,J) OF THE COMPOUND NUCLEUS. FOR NON-FISSIONABLE ISOTOPE THE MAXIMUM TIME IS 30 SECONDS.
7. UNUSUAL FEATURES OF THE PROGRAM - THERE IS AN INPUT OPTION WHICH REDUCES RUNNING TIME FOR UNRESOLVED RESONANCES BY ABOUT A FACTOR OF 2.5 BY USING A FAIRLY COARSE NUMERICAL APPROXIMATION OF THE NEUTRON AND FISSION LEVEL WIDTH DISTRIBUTIONS. MAJOR INTEREST IN THIS OPTION IS FOR PU238.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
PHILCO-2000 VERSION SUBMITTED NOVEMBER 1965.
10. REFERENCES - J. H. FERZIGER, P. GREEBLER, M. D. KELLEY, AND J. W. WALTON, RESONANCE INTEGRAL CALCULATIONS FOR EVALUATION OF DOPPLER COEFFICIENTS, THE RAPTURE CODE, GEAP-3923, JULY 1962.
NELS J. ANDERSON, JR., IDFTAP, A FORTRAN IV FUNCTION SUBPROGRAM, S6T001, JANUARY 15, 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY

12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SMART, THE GE-APED MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
J. H. FERZIGER, P. GREEBLER
M. D. KELLEY AND J. W. WALTON
GENERAL ELECTRIC COMPANY
ATOMIC POWER EQUIPMENT DEPARTMENT
SAN JOSE, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (641 CARDS)
SAMPLE PROBLEM (31 CARDS)
REFERENCE REPORTS
17. CATEGORY - A
KEYWORDS - RESONANCE INTEGRALS, FISSION, CAPTURE, CROSS SECTIONS,
UNRESOLVED REGION, RESOLVED REGION, TEMPERATURE,
PLUTONIUM 238

1. NAME OR DESIGNATION OF PROGRAM - DOPIE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - PHILCO-2000
3. NATURE OF PHYSICAL PROBLEM SOLVED - DOPIE WAS DEVELOPED TO STUDY THE EFFECTS OF -
 - (1) OVERLAP OF RESONANCES OF UNLIKE FUEL ISOTOPES SUCH AS U238 AND THE PLUTONIUM ISOTOPES, AND
 - (2) THE TEMPERATURE DEPENDENCE OF THE AVERAGE FLUX OVER AN ENERGY INTERVAL CONTAINING RESONANCES IN THE CALCULATION OF THE DOPPLER COEFFICIENT.DOPIE COMPUTES FLUX-AVERAGED CROSS SECTIONS OVER A GIVEN ENERGY RANGE UNDER THE FOLLOWING ASSUMPTION
 - (1) INTERFERENCE SCATTERING CORRECTIONS WILL BE SMALL AND CAN BE IGNORED.
 - (2) SCATTERED NEUTRONS ARE DISTRIBUTED UNIFORMLY OVER THE RANGE OF ENERGY DEGRADATION CONSTANT FOR EACH MATERIAL.
 - (3) ALL RESONANCES ARE RESOLVED OR CAN BE TREATED AS RESOLVED.
 - (4) LEAKAGE IS INSIGNIFICANT, MAKING $\Sigma R(j) = \text{POTENTIAL SCATTERING}$.
4. METHOD OF SOLUTION -
 - (1) CALCULATES PSI FUNCTIONS AND RESONANCE CROSS SECTIONS AS A FUNCTION OF ENERGY FOR EACH RESONANCE OF EACH MATERIAL.
 - (2) FOR HYPERFINE GROUP STRUCTURE CALCULATES SOURCES AND FLUXES USING ACCUMULATED CROSS SECTIONS FROM ALL NEIGHBORING RESONANCE ENERGIES.
 - (3) INTEGRATES FLUXES AND CROSS SECTIONS OVER INPUT ENERGY RANGES TO OBTAIN AVERAGE VALUES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF FUEL TEMPERATURES = 5
MAXIMUM NUMBER OF MATERIALS = 5
NUMBER OF RESOLVED RESONANCES FOR FERTILE ISOTOPE BETWEEN 2 AND 30.
6. TYPICAL RUNNING TIME - VARIES GREATLY DEPENDING UPON THE NUMBER OF RESONANCES, TYPE OF ISOTOPE AND GROUP WIDTH REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM - FINE VARIATIONS IN THE NEUTRON SCATTERING SOURCE ARE COMPUTED AND USED IN COMPUTING FLUXES.
8. RELATED AND AUXILIARY PROGRAMS - THIS PROGRAM WAS USED IN CONJUNCTION WITH THE RAVE PROGRAM WHICH IS APPLICABLE AT ENERGIES WHERE RESONANCES HAVE NOT BEEN RESOLVED. EACH RESONANCE MUST BE TREATED INDIVIDUALLY AND OVERLAPPING OF RESONANCES OF THE SAME ISOTOPE IS IGNORED.

9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
PHILCO-2000 VERSION SUBMITTED NOVEMBER 1965.
10. REFERENCES - B. A. HUTCHINS, THE EFFECTS OF RESONANCE OVERLAP ON THE DOPPLER COEFFICIENT IN A FAST CERAMIC REACTOR, COMPUTER CODES RAVE AND DOPIE, GEAP-4630, AUGUST 1964.
NELS J. ANDERSON, JR., IDFTAP, A FORTRAN IV FUNCTION SUBPROGRAM, S6T001, JANUARY 15, 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SMART, THE GE-APED MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
B. A. HUTCHINS
GENERAL ELECTRIC COMPANY
ATOMIC POWER EQUIPMENT DEPARTMENT
SAN JOSE, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (975 CARDS)
SAMPLE PROBLEM (236 CARDS)
REFERENCE REPORTS
17. CATEGORY - A
KEYWORDS - RESONANCE INTEGRALS, RESOLVED REGION, CROSS SECTIONS,
DOPPLER COEFFICIENTS

REACTOR CODE ABSTRACT 178

10/67

1. NAME OR DESIGNATION OF PROGRAM - SPARTA
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - PHILCO-2000
3. NATURE OF PHYSICAL PROBLEM SOLVED - SPARTA COMPUTES SPATIALLY-AVERAGED DOPPLER COEFFICIENTS AND SPATIALLY-AVERAGED DOPPLER REACTIVITY CHANGES.
4. METHOD OF SOLUTION - THE CORE IS SUBDIVIDED INTO I RADIAL AND J AXIAL REGIONS OF EQUAL VOLUME. THE AVERAGE FUEL ROD OF EACH REGION IS THEN DIVIDED INTO M ANNULAR REGIONS OF EQUAL VOLUME, AND AN AVERAGE TEMPERATURE COMPUTED FOR EACH OF THE IJM SUB-REGIONS. THE SPATIALLY-CORRECTED DOPPLER COEFFICIENT IS CALCULATED FROM THE SUBREGION TEMPERATURES. THE CODE ALSO CALCULATES SUBREGION TEMPERATURES, RESULTING FROM A RAPID FUEL TEMPERATURE TRANSIENT STARTING FROM THE INITIAL TEMPERATURE DISTRIBUTION, AND THE DOPPLER REACTIVITY CORRESPONDING TO THIS FUEL TEMPERATURE CHANGE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM - THE FINAL SUBREGION TEMPERATURES MAY INCLUDE VALUES ABOVE THE FUEL MELTING POINT. THE CODE TAKES INTO ACCOUNT THE FUEL HEAT OF FUSION.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
COC1604 VERSION SUBMITTED NOVEMBER 1965.
10. REFERENCES - P. GREEBLER, E. GOLDMAN, DOPPLER CALCULATIONS FOR LARGE FAST CERAMIC REACTORS, GEAP-4092, DECEMBER 1962.
NELS J. ANDERSON, JR., IDFTAP, A FORTRAN IV FUNCTION SUBPROGRAM, S6T001, JANUARY 15, 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SMART, THE GE-APED MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
P. GREEBLER AND E. GOLDMAN
GENERAL ELECTRIC COMPANY
ATOMIC POWER EQUIPMENT DEPARTMENT
SAN JOSE, CALIFORNIA

REACTOR CODE ABSTRACT 170

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16. MATERIAL AVAILABLE -
SOURCE DECK (160 CARDS)
SAMPLE PROBLEM (14 CARDS)
REFERENCE REPORTS
17. CATEGORY - 8
KEYWORDS - DOPPLER COEFFICIENT, REACTIVITY, HEATING

REACTOR CODE ABSTRACT 179

10/67

1. NAME OR DESIGNATION OF PROGRAM - ISOTOPES
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604A
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM CAN BE USED TO CALCULATE FOR ANY NEUTRON FLUX THE OPTIMUM TIME OF IRRADIATION FOR MAXIMUM YIELD, THE SPECIFIC ACTIVITY OF THE PRODUCT ISOTOPE IN CURIES PER GRAM OF TARGET MATERIAL, AND THE COMBINED SPECIFIC ACTIVITY OF THE TARGET AND PRODUCT ISOTOPES. THE PRODUCT ISOTOPE MAY BE PRODUCED BY ANY SIMPLE REACTION SUCH AS (N,GAMMA), (N,P), (N,2N), ETC., OR IT MAY BE PRODUCED BY DECAY OF A PARENT ISOTOPE.
4. METHOD OF SOLUTION - THE PROGRAM USES SOLUTIONS TO THE BATEMAN EQUATION FOR REACTION AND DECAY INCLUDING THE ANALYTICAL SOLUTION FOR OPTIMUM TIME TO PRODUCE MAXIMUM YIELD. THE INPUT DATA REQUIRED INCLUDES THE HALF-LIVES AND CROSS SECTIONS OF THE TARGET AND PRODUCT ISOTOPES, THE RELATIVE ABUNDANCE OF THE TARGET ISOTOPE IN THE ORIGINAL MATERIAL, NEUTRON FLUX VALUES, AND IRRADIATION TIME VALUES IF OPTIMUM TIME IS NOT DESIRED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE NUMBER OF FLUX VALUES USED MAY RANGE FROM 2 TO A MAXIMUM OF 100 FOR EACH INDIVIDUAL REACTION AND DECAY PROBLEM.
6. TYPICAL RUNNING TIME - THE CALCULATIONS FOR FOUR FLUX VALUES TAKE APPROXIMATELY ONE SECOND.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - CRUNCH AND ISOCRUNCH (ACC ABSTRACT 180)
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JUNE 1965.
10. REFERENCES - CHARLES W. FRIEND AND ALTON R. JENKINS, ISOTOPES - A PROGRAM FOR NEUTRON PRODUCT YIELDS AND DECAY CALCULATIONS USING A CONTROL DATA 1604A COMPUTER, ORNL-3673, JANUARY 1965.
M. P. LIETZKE AND H. C. CLAIBORNE, CRUNCH - AN IBM704 CODE FOR THE CALCULATION OF N SUCCESSIVE FIRST ORDER REACTIONS, ORNL-2958, NOVEMBER 1960.
CHARLES W. FRIEND AND J. R. KNIGHT, ISOCRUNCH - MODIFICATIONS TO THE CRUNCH PROGRAM FOR THE IBM7090, ORNL-3689, JANUARY 1965.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -

REACTOR CODE ABSTRACT 179

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14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
CHARLES W. FRIEND, ISOTOPES DIVISION
ALTON R. JENKINS, MATHEMATICS DIVISION
OAK RIDGE NATIONAL LABORATORY
OAK RIDGE, TENNESSEE
16. MATERIAL AVAILABLE -
SOURCE DECK (337 CARDS)
SAMPLE PROBLEMS (14 CARDS)
REFERENCE REPORT, ORNL-3673
17. CATEGORY - D
KEYWORDS - ISOTOPES, PRODUCTION, DECAY

REACTOR CODE ABSTRACT 180

10/67

1. NAME OR DESIGNATION OF PROGRAM - ISOCRUNCH
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090 AND CDC1604A
3. NATURE OF PHYSICAL PROBLEM SOLVED - ISOCRUNCH CAN BE USED TO COMPUTE THE AMOUNT OF EACH ISOTOPE IN A REACTION AND DECAY CHAIN FOR ANY SPECIFIED NEUTRON FLUX AND TIME, TO SUM THE CONTRIBUTIONS OF VARIOUS CHAINS TO THE SAME ISOTOPE, TO GRAPH ON AN ASSOCIATED ELECTROPLOTTER OR CALCOMP THE YIELD OF AN ISOTOPE VS. TIME FOR A GIVEN FLUX, AND TO FIND THE OPTIMUM TIME FOR MAXIMUM YIELD OF AN ISOTOPE IN A CHAIN. THE PROGRAM DOES NOT TAKE INTO ACCOUNT THE SELF-SHIELDING OF A TARGET IN A REACTOR OR THE DEPENDENCE OF REACTION CROSS SECTIONS ON NEUTRON ENERGY WHICH CAN BE HANDLED BY ADJUSTING THE INPUT DATA.
4. METHOD OF SOLUTION - THE AMOUNT OF EACH ISOTOPE IN A GIVEN REACTION AND DECAY CHAIN IS COMPUTED FROM THE EXACT ANALYTICAL SOLUTION OF THE BATEMAN EQUATIONS, WHICH DESCRIBE SUCH PROCESSES. THE GRAPHICAL OPTION OF THIS PROGRAM USES A PLOTTING SUBROUTINE WRITTEN FOR THE BENSON-LEHNER MODEL J ELECTROPLOTTER (7090) OR CALCOMP PLOTTER (1604A). OPTIMIZATION OF THE TIME FOR MAXIMUM YIELD OF AN ISOTOPE IS ACCOMPLISHED BY A GRADIENT SEARCH SUBROUTINE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THIS PROGRAM WILL HANDLE UP TO 50 ISOTOPES IN A CHAIN AND SUM SELECTED ISOTOPES UP TO 10 CHAINS.
6. TYPICAL RUNNING TIME - (IBM7090) THE RUNNING TIME ON THE COMPUTER ONLY CAN BE ESTIMATED AS ABOUT THREE SECONDS PER ISOTOPE TIMES THE NUMBER OF NONZERO INITIAL CONCENTRATIONS.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - CRUNCH AND ISOTOPES (ACC ABSTRACT 179)
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7090 VERSION SUBMITTED JUNE 1965.
CDC1604 VERSION SUBMITTED JUNE 1965.
10. REFERENCES - CHARLES W. FRIEND AND J. R. KNIGHT, ISOCRUNCH - MODIFICATION TO THE CRUNCH PROGRAM FOR THE IBM7090, ORNL-3689, JANUARY 1965.
M. P. LIETZKE AND H. C. CLAIBORNE, CRUNCH - AN IBM704 CODE FOR THE CALCULATION OF N SUCCESSIVE FIRST ORDER REACTIONS, ORNL-2958, NOVEMBER 1960.
CHARLES W. FRIEND AND ALTON R. JENKINS, ISOTOPES - A PROGRAM FOR NEUTRON PRODUCT YIELDS AND DECAY CALCULATIONS USING A CONTROL DATA 1604A COMPUTER, ORNL-3673, JANUARY 1965.

11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM7090)
FORTRAN 63 (CDC1604A)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
CHARLES W. FRIEND, ISOTOPES DIVISION
OAK RIDGE NATIONAL LABORATORY
J. R. KNIGHT, CDP DIVISION
OAK RIDGE GASEOUS DIFFUSION PLANT
OAK RIDGE, TENNESSEE
16. MATERIAL AVAILABLE -
7090 SOURCE DECKS (SUM AND PLOT-374 CARDS, OPTIMIZE-338 CARDS,
SUM AND OPTIMIZE-336 CARDS)
BINARY DECK (7090 PLOT PACKAGE-86 CARDS)
SAMPLE PROBLEMS (OPTIMIZE, SUM AND OPTIMIZE-16 CARDS)
1604A SOURCE DECKS INCLUDING PLOT PACKAGE (1527 CARDS)
REFERENCE REPORT, ORNL-3689
17. CATEGORY - D
KEYWORDS - ISOTOPES, PRODUCTION, DECAY, GRAPHS, SUM CODES,
OPTIMIZE CODES, PLOT CODES

REACTOR CODE ABSTRACT 181

10/67

1. NAME OR DESIGNATION OF PROGRAM - XLIBIT
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - USING THE ANL STANDARD CROSS SECTION DATA CARDS AS INPUT, THE PROGRAM CAN PERFORM THE FOLLOWING OPERATIONS -
 - (A) PREPARE A LIBRARY TAPE CONSISTING OF THE CROSS SECTION DATA FOR SETS OF MATERIALS, INCLUDING A DIRECTORY GIVING THE SETS ON THE TAPE AND THE MATERIALS IN EACH SET,
 - (B) GIVEN AN EXISTING LIBRARY TAPE, THE PROGRAM CAN PREPARE A DUPLICATE TAPE OR A MODIFIED TAPE, THE MODIFICATIONS CONSISTING OF THE ADDITION AND DELETION OF SETS, THE ADDITION AND DELETION OF MATERIALS WITHIN A SET, AND THE RE-ORDERING OF THE SETS ON THE TAPE,
 - (C) ANY OF THE DATA ON A LIBRARY TAPE MAY BE PRINTED, AND THE PROGRAM WILL PUNCH THE CROSS SECTION DATA CARDS THAT WERE USED TO PLACE ANY OF THE MATERIALS OR SETS ON THE TAPE WITH ALTERED SET AND MATERIAL NAMES IF DESIRED.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA ARE -
300 SETS ON A LIBRARY TAPE
500 MATERIALS IN A SINGLE SET
100 ENERGY GROUPS IN A SET
6. TYPICAL RUNNING TIME - XLIBIT CAN ADD DATA TO THE LIBRARY AT A RATE OF ABOUT 850 CARDS PER MINUTE AND CAN COPY A MATERIAL FROM AN OLD TO AN UPDATED TAPE IN 10 SECONDS OR LESS. TYPICAL RUNNING TIMES ARE 2 TO 10 MINUTES, DEPENDING ON THE SIZE OF THE INPUT DECK AND THE NUMBER OF SETS ON THE OLD TAPE.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - THE LIBRARY TAPE FORMED BY THIS PROGRAM IS USED AS AN INPUT TAPE BY THE REACTOR CODES CANDID1D, CANDID2D, SNARG1D, AND SNARG2D. SECTIONS OF XLIBIT ARE INCORPORATED INTO THESE REACTOR CODES TO PERMIT MODIFICATION OF CROSS SECTION VALUES FOR A PARTICULAR PROBLEM AT RUN TIME.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC3600 VERSION SUBMITTED NOVEMBER 1965, SAMPLE PROBLEM EXECUTED BY ACC.
10. REFERENCES - ANL-AMD TECHNICAL MEMORANDUM 93, JANUARY 7, 1965.
ANL-AMD TECHNICAL MEMORANDUM 94, JANUARY 15, 1965.
S. D. SPARCK, XLIBIT - ANL CROSS SECTION LIBRARY CODE, ANL-7112, FEBRUARY 1966.

11. MACHINE REQUIREMENTS - PROGRAM AS WRITTEN IS DESIGNED FOR A TWO-BANK (64K) CDC3600 AND MAKES USE OF 6 MAGNETIC TAPE UNITS, EXCLUDING STANDARD INPUT, OUTPUT, AND PUNCH UNITS. WITH MINOR MODIFICATIONS THE CORE REQUIRED MAY BE REDUCED TO 32K, AND THE NUMBER OF TAPES TO 3 PLUS STANDARD INPUT AND OUTPUT UNITS. THIS, HOWEVER, WILL IN GENERAL RESTRICT THE FUNCTIONING OF THE PROGRAM AND THE SIZE (E.G., NUMBER OR ORDER OF ANISOTROPIC SCATTERING) OF A MATERIAL THAT MAY BE PLACED ON THE LIBRARY TAPE.
12. PROGRAMMING LANGUAGE USED - 3600 FORTRAN
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - PROGRAM IS DESIGNED TO RUN UNDER SCOPE ON THE CDC3600.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - PROGRAM MAKES LIMITED USE OF SUBROUTINE PARAMETERS AND DOES NOT USE DYNAMIC STORAGE ALLOCATION. HEAVY USE IS MADE OF BUFFERED INPUT/OUTPUT COMMANDS.
15. NAME AND ESTABLISHMENT OF AUTHORS -
S. D. SPARCK
APPLIED MATHEMATICS DIVISION
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439

E. MUELLER
CONTROL DATA CORPORATION
COMPUTER DIVISION
PALO ALTO, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3887 CARDS)
BINARY DECK (1768 CARDS)
SAMPLE PROBLEM (315 CARDS)
REFERENCE REPORT, ANL-7112
17. CATEGORY - M
KEYWORDS - CROSS SECTIONS, LIBRARIES, PREPARATION, MAINTENANCE, RETRIEVAL

REACTOR CODE ABSTRACT 182

10/67

1. NAME OR DESIGNATION OF PROGRAM - AXFLU
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - AXFLU CALCULATES HEAT TRANSFER FROM A LATTICE OF FLUID CYLINDRICAL FUEL PINS TO COOLANT IN EITHER SLUG OR FULLY-DEVELOPED LAMINAR FLOW. SOLUTION IS ANALYTIC AND CLOSED, EXCEPT FOR SATISFYING BOUNDARY CONDITIONS AT A FINITE, (BUT ARBITRARY), NUMBER OF BOUNDARY POINTS.
4. METHOD OF SOLUTION - INFINITE SERIES REPRESENTATIONS FOR TEMPERATURE AND VELOCITY FIELDS IN EACH OF THE THREE REGIONS - THE MOLTEN REACTOR FUEL REGION, THE TUBE WALL REGION, AND THE COOLANT REGION ARE OBTAINED BY THE METHOD OF FINITE FOURIER COSINE TRANSFORMS. THE MOLTEN REACTOR FUEL IS ASSUMED IN LAMINAR, FREE CONVECTIVE FLOW, AND TO BE A NEWTONIAN FLUID. THE COOLANT IS ASSUMED IN FORCED CONVECTION. ALL PHYSICAL PROPERTIES EXCEPT THE MOLTEN FUEL REGION DENSITY ARE ASSUMED CONSTANT, AND IT IS FURTHER ASSUMED THAT THE THERMAL AND HYDRODYNAMIC BOUNDARY LAYERS ARE FULLY DEVELOPED, SO THAT THE TWO-DIMENSIONAL PROBLEM IS CONSIDERED. THE EXPANSION COEFFICIENTS OF THE SERIES ARE FOUND BY MATRIX INVERSION AND THE SERIES ARE TRUNCATED AT N TERMS. N IS THE NUMBER OF POINTS AT WHICH THE HOMOGENEOUS NEUMANN BOUNDARY CONDITIONS ARE SATISFIED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - AN INFINITE, PERFECT LATTICE OF FUEL ELEMENTS IS CONSIDERED.
6. TYPICAL RUNNING TIME - 1 TO 3 SECONDS PER SET OF INPUT PARAMETERS ARE REQUIRED FOR A FULLY ADEQUATE SOLUTION (5 FIGURE ACCURACY).
7. UNUSUAL FEATURES OF THE PROGRAM - EITHER SLUG OR LAMINAR COOLANT FLOW IS TREATED. IN ADDITION, AXFLU CONSIDERS FUEL IN FREE NATURAL CONVECTION.
8. RELATED AND AUXILIARY PROGRAMS - USES STANDARD MATRIX INVERSION ROUTINE, BESSEL FUNCTION ROUTINE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7094 VERSION SUBMITTED JULY 1965.
10. REFERENCES - ROY A. AXFORD, MULTIREGION THERMAL ANALYSIS OF TUBE BUNDLES WITH MOLTEN REACTOR FUEL IN FREE CONVECTION, LA-3168, SEPTEMBER 15, 1964.
W. H. HANNUM, INPUT FOR CODES FOR CALCULATING THERMAL PROPERTIES OF TUBES IN HEX LATTICES, MEMORANDUM, JUNE 15, 1965.
11. MACHINE REQUIREMENTS - 16K CORE STORAGE
12. PROGRAMMING LANGUAGE USED - FORTRAN II

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
FORTRAN II MONITOR WITH INPUT TAPE = 10, OUTPUT TAPE = 9.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
WILLIAM H. HANNUM
LOS ALAMOS SCIENTIFIC LABORATORY
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO 87544
16. MATERIAL AVAILABLE -
SOURCE DECK WITH BINARY DECKS FOR LIBRARY ROUTINES (637 CARDS)
SAMPLE PROBLEMS (4 CARDS)
REFERENCE REPORT AND MEMORANDUM
17. CATEGORY - H
KEYWORDS - HEAT TRANSFER, LATTICES, FLUIDS FUEL ELEMENTS, CYLINDERS

REACTOR CODE ABSTRACT 183

10/67

1. NAME OR DESIGNATION OF PROGRAM - AXTHRM
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - AXTHRM CALCULATES HEAT TRANSFER FROM A TRIANGULAR LATTICE OF CLAD SOLID CYLINDRICAL FUEL PIN TO COOLANT IN EITHER SLUG OR FULLY-DEVELOPED LAMINAR FLOW. SOLUTION IS ANALYTIC AND CLOSED, EXCEPT FOR SATISFYING BOUNDARY CONDITIONS AT A FINITE, (BUT ARBITRARY), NUMBER OF BOUNDARY POINTS.
4. METHOD OF SOLUTION - ANALYTICAL EXPRESSIONS FOR THE TEMPERATURE AND VELOCITY FIELDS OCCURRING IN THE NUCLEAR FUEL REGION, THE TUBE WALL AND THE COOLANT REGIONS ARE OBTAINED BY THE METHOD OF FINITE FOURIER COSINE TRANSFORMS IN THE FORM OF INFINITE SERIES REPRESENTATIONS. UNDER THE ASSUMPTIONS OF THERMALLY ISOTROPIC MATERIALS AND CONSTANT PHYSICAL PROPERTIES, WITH COOLANT EITHER IN SLUG OR LAMINAR FLOW. THE SERIES ARE TRUNCATED AT N TERMS WHERE N IS THE NUMBER OF POINTS AT WHICH THE HOMOGENEOUS NEUMANN BOUNDARY CONDITIONS ARE SATISFIED. THE EXPANSION COEFFICIENTS IN THE SERIES ARE OBTAINED BY MATRIX INVERSION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - AN INFINITE, PERFECT LATTICE OF FUEL ELEMENTS IS CONSIDERED.
6. TYPICAL RUNNING TIME - 1 TO 3 SECONDS PER SET OF INPUT PARAMETERS ARE REQUIRED FOR A FULLY ADEQUATE SOLUTION (5 FIGURE ACCURACY).
7. UNUSUAL FEATURES OF THE PROGRAM - EITHER SLUG OR LAMINAR COOLANT FLOW IS TREATED.
8. RELATED AND AUXILIARY PROGRAMS - USES STANDARD MATRIX INVERSION ROUTINE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7094 VERSION SUBMITTED JULY 1965.
10. REFERENCES - ROY A. AXFORD, MULTIREGION ANALYSIS OF TEMPERATURE FIELDS AND HEAT FLUXES IN TUBE BUNDLES WITH INTERNAL, SOLID, NUCLEAR HEAT SOURCES, LA-3167, SEPTEMBER 8, 1964.
W. H. HANNUM, INPUT FOR CODES FOR CALCULATING THERMAL PROPERTIES OF TUBES IN HEX LATTICES, MEMORANDUM, JUNE 15, 1965.
11. MACHINE REQUIREMENTS - 16K STORAGE
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN II MONITOR WITH INPUT TAPE = 10, OUTPUT TAPE = 9.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

WILLIAM H. HANNUM
LOS ALAMOS SCIENTIFIC LABORATORY
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO 87544

16. MATERIAL AVAILABLE -

SOURCE DECK WITH BINARY DECKS FOR LIBRARY ROUTINES (566 CARDS)
SAMPLE PROBLEM (4 CARDS)
REFERENCE REPORT AND MEMORANDUM

17. CATEGORY - H

KEYWORDS - HEAT TRANSFER, LATTICES, SOLIDS FUEL ELEMENTS, CYLINDERS

REACTOR CODE ABSTRACT 184

10/67

1. NAME OR DESIGNATION OF PROGRAM - THERMOS (ANL VERSION)
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - THIS ABSTRACT REFERS SPECIFICALLY TO THE VERSION OF THE CODE DESIGNED FOR USE ON THE CDC3600 COMPUTER. VERSIONS OF THE CODE WERE WRITTEN ORIGINALLY FOR THE IBM704/709/7090 MACHINES.
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS ARGONNE-REVISED VERSION LIKE THE ORIGINAL THERMOS CODE DEVELOPED BY H. HONECK OF BROOKHAVEN NATIONAL LABORATORY COMPUTES THE SCALAR THERMAL NEUTRON SPECTRUM AS A FUNCTION OF POSITION IN A LATTICE BY SOLVING THE INTEGRAL TRANSPORT EQUATION WITH ISOTROPIC SCATTERING. ONE-DIMENSIONAL SLAB OR CYLINDRICAL GEOMETRY MAY BE USED. AS OUTPUT THE CODE SUPPLIES FLUX-AVERAGED VALUES OF SIGMA A, SIGMA F, NU SIGMA F, SIGMA S, AND D FOR THE CELL COMPOSITION AND THE VALUES OF SIGMA A, SIGMA F, NU SIGMA F, SIGMA S, AND SIGMA TR FOR THE ISOTOPIC CONSTITUENTS.
4. METHOD OF SOLUTION - THE METHOD USED IN SOLVING THE TRANSPORT INTEGRAL EQUATION IS THE POWER ITERATION METHOD. TO ACCELERATE CONVERGENCE THE CODE USES A COMBINATION OF GAUSS ITERATION, RENORMALIZATION, OVER-RELAXATION, AND EXTRAPOLATION PROCEDURES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

MAXIMUM NUMBER OF SPEED GROUPS	50
MAXIMUM NUMBER OF SPACE POINTS	20
MAXIMUM NUMBER OF ISOTOPES IN MIXTURE	25
MAXIMUM NUMBER OF ISOTOPES IN THE EDIT	25
MAXIMUM NUMBER OF MIXTURES	5
6. TYPICAL RUNNING TIME - THE SAMPLE PROBLEM INCLUDED IN THE CODE PACKAGE TOOK SIX MINUTES ON THE 3600. THE PROBLEM IS A 2-REGION SLAB AND IS SOLVED USING 10 SPACE POINTS AND 30 SPEED GROUPS. THERE ARE 2 MIXTURES USED. 5 MATERIALS ARE USED IN THE CELL AND IN THE EDIT. THE TIME IN GENERAL IS A FUNCTION OF THE NUMBER OF SPACE POINTS AND ENERGY GROUPS USED BY THE PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM - THE PROGRAM PERMITS AN AUTOMATED SEQUENCE IN WHICH ONE PROBLEM GENERATES A CORRECT ENERGY-DEPENDENT SPATIALLY-AVERAGED SET OF CROSS SECTIONS FOR USE IN THE NEXT PROBLEM. THIS GENERATING FEATURE FACILITATES THE SOLUTION OF GEOMETRICALLY COMPLEX SYSTEMS.
8. RELATED AND AUXILIARY PROGRAMS -

LIBP	- PREPARES THE CROSS SECTION LIBRARY TAPE USED BY THERMOS.
GAKER	- IS THE ASSOCIATED NELKIN KERNEL CODE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC3600 VERSION SUBMITTED AUGUST 1965, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - H. C. HONECK, A THERMALIZATION TRANSPORT THEORY CODE FOR REACTOR LATTICE CALCULATIONS, BNL-5826, SEPTEMBER 1961.
H. C. HONECK, THE DISTRIBUTION OF THERMAL NEUTRONS IN SPACE AND ENERGY IN REACTOR LATTICES PART 1 - THEORY, NUCLEAR SCIENCE AND ENGINEERING, P. 193, 1960.
B. TOPPEL AND I. BAKSYS, THE ARGONNE REVISED THERMOS CODE, ANL-7023, MARCH 1965.
11. MACHINE REQUIREMENTS - THE CODE REQUIRES A 2-BANK 3600 COMPUTER WITH 6 TAPE UNITS, EACH BANK HAVING 32K STORAGE CAPACITY.
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD COC3600 SCOPE MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - DUE TO THE SIZE OF THERMOS, STORAGE SPACE HAD TO BE ALLOCATED BY THE PROGRAMMER. THE BANK CARDS (STORAGE ALLOCATION CARDS) ARE INCLUDED IN THE PROGRAM.
15. NAME AND ESTABLISHMENT OF AUTHORS -
I. BAKSYS AND B. TOPPEL
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (THERMOS 1895 CARDS, LIBP 518 CARDS, AND GAKER 349 CARDS)
BINARY DECKS (LIBP 395 CARDS AND GAKER 172 CARDS)
SAMPLE PROBLEMS (THERMOS 33 CARDS, LIBP 186 CARDS, AND GAKER 29 CARDS)
OUTPUT (GAKER 324 CARDS)
REFERENCE REPORTS, ANL-7023 AND BNL-5826
17. CATEGORY - B
KEYWORDS - THERMAL SPECTRA, TRANSPORT THEORY, LATTICES, SLABS, CYLINDERS, 1-DIMENSIONAL, ISOTROPIC SCATTERING, CROSS SECTIONS, LIBP CODES, GAKER CODES

1. NAME OR DESIGNATION OF PROGRAM - GAMTEC2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, UNIVAC1107
3. NATURE OF PHYSICAL PROBLEM SOLVED - GAMTEC2 GENERATES MULTIGROUP CONSTANTS IN THE ENERGY RANGE FROM 0 TO 10 MEV FOR EITHER HOMOGENEOUS MIXTURES OR HETEROGENEOUS ARRAYS CONSISTING OF CYLINDERIZED LATTICE CELLS. THE THERMAL GROUP CONSTANTS ARE AVERAGED OVER EITHER (1) WIGNER-WILKINS LIGHT MODERATOR SPECTRUM, (2) WILKINS HEAVY MODERATOR SPECTRUM, OR (3) A MAXWELLIAN DISTRIBUTION. FOR HETEROGENEOUS ARRAYS THE SPATIAL THERMAL FLUX IS CALCULATED BY A MONOENERGETIC P3 APPROXIMATION. FOR EPITHERMAL ENERGIES, THE SLOWING-DOWN DISTRIBUTION IS DESCRIBED BY EITHER A B1 OR P1 APPROXIMATION TO THE BOLTZMANN EQUATION. RESONANCE ABSORPTION AND FISSION ARE TREATED BY THE ADLER-NORDHEIM METHOD. AN IMPROVED METHOD OVER THAT IN GAM-1 FOR AVERAGING THE RESONANCE ABSORPTION CONTRIBUTION TO THE MULTIGROUP CONSTANTS IS INCLUDED. FUEL LUMPING EFFECTS ON THE FAST FISSION OF U238 AND TH232 ARE TREATED BY AN N-FLIGHT COLLISION PROBABILITY TECHNIQUE. GROUP CONSTANTS ARE PUNCHED ON CARDS IN HFN (DIFFUSION CODE) AND DTF (SN TRANSPORT CODE) FORMATS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE MAXIMUM NUMBER OF CONCENTRIC REGIONS IN THE UNIT LATTICE CELL IS SIXTEEN. EACH REGION MAY CONTAIN UP TO TEN ISOTOPES. GROUP CONSTANTS MAY BE COMPUTED FOR ONE THERMAL GROUP AND FROM 1 TO 34 EPITHERMAL GROUPS.
6. TYPICAL RUNNING TIME - A PROBLEM REQUIRES FROM ONE TO THREE MINUTES ON THE IBM7090, DEPENDING ON THE COMPLEXITY AND OPTIONS UTILIZED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - GAMTEC2 COMBINES THE ATOMICS INTERNATIONAL TEMPEST (ACC ABSTRACT 50) AND THE GENERAL ATOMIC GAM1 (ACC ABSTRACT 33) CODES TO COMPUTE MULTIGROUP CONSTANTS FOR BOTH THERMAL AND EPITHERMAL NEUTRONS IN ONE OPERATION. THE GAM1 CODE HAS BEEN EXTENDED TO TREAT RESONANCE FISSION BY THE ADLER-NORDHEIM METHOD. ALSO, AN IMPROVED METHOD WAS USED FOR AVERAGING THE RESONANCE ABSORPTION CONTRIBUTION TO THE MULTIGROUP CONSTANTS.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7090 VERSION SUBMITTED SEPTEMBER 1965.
UNIVAC1107 VERSION SUBMITTED FEBRUARY 1967.
10. REFERENCES - L. L. CARTER, C. R. RICHEY AND C. E. HUGHEY, GAMTEC-11 - A CODE FOR GENERATING CONSISTENT MULTIGROUP CONSTANTS UTILIZED IN DIFFUSION AND TRANSPORT THEORY CALCULATIONS, BNWL-35, MARCH 1965, AND ERRATA.

10. REFERENCES (CONTINUED)

C. R. RICHEY, NOTE TO USERS OF 7090 VERSION OF
GAMTEC-II, FEBRUARY 1967.

C. R. RICHEY, GAMTEC-II NOTE, FEBRUARY 1967.

11. MACHINE REQUIREMENTS - THE CODE REQUIRES THE USE OF TWO TAPE UNITS
IN ADDITION TO THE USUAL INPUT AND OUTPUT UNITS UTILIZED IN THE
IBM FORTRAN-II MONITOR SYSTEM - ONE UNIT FOR THE SINGLE DATA
LIBRARY TAPE AND A SCRATCH TAPE IS MOUNTED ON THE OTHER. ALSO,
AN ON-LINE CARD PUNCH IS REQUIRED.

12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP (7090) AND
FORTRAN IV (1107)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - THE
CODE IS EXECUTED ON THE IBM7090 UNDER THE IBM FORTRAN II MONITOR
SYSTEM WITH INPUT ON TAPE NUMBER 2 AND OUTPUT ON TAPE NUMBER 3.
ON THE UNIVAC1107 THE CODE IS EXECUTED UNDER THE UNIVAC1107
MONITOR SYSTEM (EXEC 11).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

L. L. CARTER AND C. R. RICHEY
BATTELLE-NORTHWEST LABORATORIES
RICHLAND, WASHINGTON

C. E. HUGHEY
GENERAL ELECTRIC COMPANY
RICHLAND, WASHINGTON

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS, SAMPLE PROBLEMS, BCD LIBRARIES (7090-20648 CARDS,
1107-22338 CARDS)
BINARY LIBRARY (FILES 2,3,4-460 RECORDS)
REFERENCE REPORT, ERRATA, AND NOTES

17. CATEGORY - B

KEYWORDS - MULTIGROUP GROUP CONSTANTS, SPECTRA, LATTICES, CYLIN-
DERS, WIGNER-WILKINS MODEL, LIGHT MODERATORS, WILKINS
EQUATION, HEAVY MODERATORS, MAXWELL DISTRIBUTION, PL
METHOD, BL METHOD, THERMAL, EPITHERMAL

REACTOR CODE ABSTRACT 186

10/67

1. NAME OR DESIGNATION OF PROGRAM - LAG1/LAG2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B
3. NATURE OF PHYSICAL PROBLEM SOLVED - LAG IS A SINGLE PASS LOAD AND GO ASSEMBLER DESIGNED TO ACCEPT IBM7090 FLOCO II INSTRUCTIONS.
4. METHOD OF SOLUTION - ALL INSTRUCTIONS, DATA AND REMARKS ARE STORED FORWARD IN THE LAG ASSEMBLER. EACH FLOCO II INSTRUCTION IS REPLACED BY A STRING OF CODAP-1 INSTRUCTIONS. THE GENERATOR STRINGS ARE INDEPENDENT OF ONE ANOTHER.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 30 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - LAG ACCEPTS TDC, DSN, 2DXY, MGDSN, DTX, AND DTK PROGRAMS.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965, WITH A FEW OPTIONS AS YET UNTESTED.
10. REFERENCES - BENGT CARLSON, CHESTER S. KAZEK, JR., AND CLARENCE E. LEE, FLOCO II MANUAL, LAMS-2339, OCTOBER 1959.
R. LAWRENCE, LAG A LOAD AND GO ASSEMBLER WRITTEN FOR THE CDC1604B COMPUTER, TIM-939, JULY 22, 1965.
11. MACHINE REQUIREMENTS - 32K STORAGE, STANDARD INPUT/OUTPUT UNITS.
12. PROGRAMMING LANGUAGES USED - FORTRAN 63 (95 PER CENT)
CODAP-1 (5 PER CENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - MASTER CONTROL SYSTEM (MCS).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - PROGRAM PRESENTLY RUNNING ON ON-LINE SYSTEM.
15. NAME AND ESTABLISHMENT OF AUTHOR -
RAYMOND E. LAWRENCE (LAG1)
J. E. SHUTTLEWORTH (LAG2)
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (9912 CARDS)
SOURCE DECKS (LAG1 AND LAG2)
SAMPLE PROBLEMS (LAG1-DSN, LAG2-2DXY, DTK, TDC, DSN)
REFERENCE REPORT, TIM-939

REACTOR CODE ABSTRACT 186

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10/67

17. CATEGORY - P
KEYWORDS - ASSEMBLER, PROGRAMMING LANGUAGE

REACTOR CODE ABSTRACT 187

10/67

1. NAME OR DESIGNATION OF PROGRAM - CENTRIFUGAL PUMP IMPELLER DESIGN SYSTEM

(A) MERIDIONAL PLANE VELOCITY PROGRAM	4272
(B) COMPLETE CO-ORDINATES	4439
(C) MILLING CO-ORDINATES	4329
(D) MINIMUM CHANNEL WIDTH	M.C.C.W.
(E) MACHINING	4433
(F) INSPECTION CO-ORDINATES	4293
(G) IMPELLER REDESIGN	B-539
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS SYSTEM HAS BEEN DEVELOPED FOR THE DESIGN AND DEVELOPMENT OF HIGH SPEED TURBO-MACHINERY FOR PUMPING HIGH TEMPERATURE LIQUID METALS. AFTER INITIALIZING THE ANALYSIS AND DESIGN EFFORT BY ESTABLISHING THE PUMP CONDITIONS OF SERVICE THE CODES ARE USED TO DEFINE THE PUMP IMPELLER DESIGN. IN ALL PROGRAMS, REAL FLUID EFFECTS ARE NOT CONSIDERED. THE MACHINING CODE PRODUCES A PAPER TAPE FOR USE IN THE ACTUAL FABRICATION OF THE IMPELLER.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE MAXIMUM TIP SURFACE RADIUS OF CURVATURE PERMISSIBLE IS 6 INCHES. BECAUSE OF THE FINITE THICKNESS END MILL AN IRREGULAR STEPPED PATTERN IS MACHINED INTO THE HUB SURFACE. THE IMPELLER VANE THICKNESS DISTRIBUTION CANNOT BE COMPLETELY CONTROLLED. THE POINT-TO-POINT MACHINING PROCESS PRODUCES A SCALLOPED PATTERN ALONG THE IMPELLER VANE SURFACE.
6. TYPICAL RUNNING TIME -

MAXIMUM TIME PER CASE ON ALL BUT MACHINING CODE = 5 MINUTES.
 MINIMUM TIME PER CASE = 1 MINUTE.
 THE MACHINING CODE USED 10 MINUTES PER CASE MINIMUM, 40 MINUTES PER CASE MAXIMUM.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - ALTHOUGH THE SEVEN CODES CONSTITUTE THE PACKAGE, EACH CODE CAN BE RUN AS A SEPARATE PROGRAM.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
 CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCES - R. P. LAMERS, CENTRIFUGAL PUMP IMPELLER DESIGN SYSTEM, TIM-918, JULY 24, 1965.
 J. M. BOURQUE, USERS REPORT FOR PUMP IMPELLER CODES, TIM-949, JULY 30, 1965.

10. REFERENCES (CONTINUED)
D. P. DALEY, DISSERTATION OF JET PUMP ANALYSIS,
TIM-913, JUNE 18, 1965.
11. MACHINE REQUIREMENTS - 32K STORAGE, 2 MAGNETIC TAPES, AND CARD
READER, AND PRINTER (ON LINE), WITH PAPER TAPE FACILITY.
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
MASTER CONTROL SYSTEM (MCS).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
J. BOURQUE
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (4241 CARDS)
SOURCE DECK
SAMPLE PROBLEM
REFERENCE REPORTS
17. CATEGORY - I
KEYWORDS - PUMPS, DESIGN, LIQUID METALS

REACTOR CODE ABSTRACT 188

10/67

1. NAME OR DESIGNATION OF PROGRAM - CMPXMAT
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B
3. NATURE OF PHYSICAL PROBLEM SOLVED - A SYSTEM OF N LINEAR EQUATIONS DERIVED FROM THE LAPLACE TRANSFORM OF A SET OF LINEARIZED DIFFERENTIAL EQUATIONS IS SOLVED FOR AMPLITUDE AND PHASE ANGLE AS A FUNCTION OF FREQUENCY.
4. METHOD OF SOLUTION - FOR EACH FREQUENCY THE COEFFICIENT MATRIX AND ITS CROUT REDUCTION ARE USED AS CONSTANTS FOR ITERATIVE REFINEMENT OF THE SOLUTION VECTOR.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - N MUST BE LESS THAN OR EQUAL TO 70.
6. TYPICAL RUNNING TIME - FOR N = 44 AND TWO FREQUENCIES THE TOTAL TIME IS 2.34 MINUTES. LOADING OF PROGRAM AND DATA CARDS AND PRINTING USED 1.5 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCE - P. G. KVICK, CMPXMAT, A TRANSFER FUNCTION EVALUATION PROGRAM, TIM-940, JULY 12, 1965.
11. MACHINE REQUIREMENTS - 32K STORAGE WITH 3 MAGNETIC TAPES AND THE STANDARD INPUT AND OUTPUT UNITS
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - MASTER CONTROL SYSTEM (MCS).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - PRESENTLY RUNNING ON ON-LINE SYSTEM.
15. NAME AND ESTABLISHMENT OF AUTHOR -
PAUL G. KVICK
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT
16. MATERIAL AVAILABLE -
SOURCE DECK (248 CARDS)
SAMPLE PROBLEM (129 CARDS)
REFERENCE REPORT

17. CATEGORY - E
KEYWORDS - TRANSFER FUNCTIONS, FREQUENCY

REACTOR CODE ABSTRACT 189

10/67

1. NAME OR DESIGNATION OF PROGRAM - SNC
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B
3. NATURE OF PHYSICAL PROBLEM SOLVED - CALCULATION OF SN CONSTANTS FOR DSN AND TDC.
4. METHOD OF SOLUTION - SEE REFERENCE 1.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMUM SN ORDER IS 32.
6. TYPICAL RUNNING TIME - TIMES ARE DEPENDENT ON SN ORDER REQUIRED. THE MAXIMUM SN ORDER SHOULD RUN IN A FEW MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - DOUBLE PRECISION IS USED.
8. RELATED AND AUXILIARY PROGRAMS - DSN-THE 1-D SN THEORY CODE AND TDC-THE 2-D SN THEORY CYLINDRICAL GEOMETRY PROGRAM.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCES - B. CARLSON, NUMERICAL SOLUTION OF TRANSIENT AND STEADY-STATE NEUTRON TRANSPORT PROBLEMS, LA-2260, 1959.
R. J. RODGERS AND R. E. LAWRENCE, SNC - CALCULATION OF SN CONSTANTS FOR TDC, DSN, TIM-932, JULY 14, 1965.
11. MACHINE REQUIREMENTS - CDC1604B WITH INPUT AND OUTPUT TAPE UNITS
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD CDC COOP MONITOR SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
R. J. RODGERS AND R. E. LAWRENCE
PRATT AND WHITNEY AIRCRAFT-CANAL
MIDDLETOWN, CONNECTICUT
16. MATERIAL AVAILABLE -
SOURCE DECK (174 CARDS)
SAMPLE PROBLEM (4 CARDS)
REFERENCE REPORT, TIM-932
17. CATEGORY - L
KEYWORDS - INPUT DATA PREPARATION, SN METHOD PARAMETERS

1. NAME OR DESIGNATION OF PROGRAM - WOPEXPRT, WEIGHT OPTIMIZATION PARAMETRIC CODE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - ORIGINALLY DESIGNED FOR THE IBM7090, BUT PRESENTLY OPERABLE ON THE CDC1604B.
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PURPOSE OF THE CODE IS TO CHOOSE THE LIGHTEST REACTOR RESULTING FROM ALL POSSIBLE COMBINATIONS OVER THE RANGE OF REACTOR INDEPENDENT VARIABLES SPECIFIED. THE ENGINEERING CALCULATIONS FOR EACH REACTOR DESIGN ARE BASED ON A LIQUID-COOLED CYLINDRICAL REACTOR HAVING PIN-TYPE FUEL ELEMENTS. REACTOR CONTROL IS ASSUMED TO BE EFFECTED BY MOVABLE SIDE REFLECTORS SURROUNDING THE CORE. NECESSARY PHYSICS DATA IS INPUT IN THE FORM OF SECOND-DEGREE EQUATIONS AS A FUNCTION OF THE INDEPENDENT VARIABLES.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - A MAXIMUM OF FOUR REACTOR INDEPENDENT VARIABLES ARE ALLOWED.
6. TYPICAL RUNNING TIME - A TYPICAL OPTIMIZATION TAKES ABOUT TEN MINUTES TO RUN DEPENDING ON THE RANGE OF INDEPENDENT VARIABLES CONSIDERED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - THE COMPOSITE DESIGN CODE (APEX-303) IS USED TO OBTAIN THE SECOND DEGREE EQUATIONS USED TO SPECIFY THE PHYSICS DATA AS A FUNCTION OF THE INDEPENDENT VARIABLES.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCES - R. W. FISH AND R. E. KILLEN, THE REACTOR WEIGHT OPTIMIZATION PARAMETRIC CODE, TIM-807, JULY 22, 1965.
J. M. KRASE AND C. CYL-CHAMPLIN, SYNTHETIC EXPERIMENT DESIGN TECHNIQUES IN REACTOR ANALYSIS, APEX-303.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

REACTOR CODE ABSTRACT 190

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15. NAME AND ESTABLISHMENT OF AUTHORS -

ROBERT W. FISH AND ROBERT E. KILLEN
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT

16. MATERIAL AVAILABLE -

SOURCE DECK (1333 CARDS)
REFERENCE REPORT, TIM-807

17. CATEGORY - I

KEYWORDS - REACTORS, WEIGHT DESIGN, LIQUID COOLANTS, CYLINDERS

1. NAME OR DESIGNATION OF PROGRAM - AX-TNT
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B
3. NATURE OF PHYSICAL PROBLEM SOLVED - AX-TNT SOLVES
 - (A) THE COUPLED HYDRODYNAMIC, THERMODYNAMIC AND NEUTRONIC EQUATIONS WHICH DESCRIBE A SPHERICAL, SUPER-PROMPT CRITICAL REACTOR SYSTEM DURING AN EXCURSION,
 - (B) THE COUPLED EQUATIONS OF MOTION, AND IDEAL GAS EQUATION OF STATE FOR THE DETONATION OF A SPHERICAL CHARGE IN A GAS.
4. METHOD OF SOLUTION -
 - (A) AS IN THE AX1 CODE THE SN NEUTRONICS SECTION OF THE CODE CALCULATES THE INVERSE PERIOD AND THE RELATIVE POWER DISTRIBUTION. THE INVERSE PERIOD AND POWER DISTRIBUTION ARE USED FOR CALCULATING THE POWER LEVEL AND FOR ASSIGNING THE ENERGY ADDED TO A GIVEN REGION. DURING SHORT TIME INTERVALS HYDRODYNAMIC AND THERMODYNAMIC CALCULATIONS DETERMINE THE ACCELERATION, VELOCITY, POSITION, DENSITY, PRESSURE, INTERNAL ENERGY, KINETIC ENERGY AND TEMPERATURE OF INDIVIDUAL REGIONS OR MASS POINTS. CODE TESTS SEND THE PROBLEM TO ADDITIONAL THERMODYNAMIC-HYDRODYNAMIC CALCULATIONS OR TO NEUTRONICS CALCULATIONS AS THE PROBLEM PROGRESSES. SEVERAL DIFFERENT EQUATIONS OF STATE AND COMBINATIONS OF EQUATIONS OF STATE ARE USED IN THE HYDRODYNAMIC-THERMODYNAMIC SECTION OF THE CODE, NAMELY - THE LINEAR, CLAUSIUS-CLAPEYRON, AND IDEAL GAS EQUATIONS OF STATE.
 - (B) THE NEUTRONICS SECTION OF THE AX-TNT CODE IS ENTIRELY BYPASSED. AN IDEAL GAS EQUATION OF STATE IS USED IN CONJUNCTION WITH THE VON NEUMANN AND RICHTMYER VISCOUS PRESSURE IN THE HYDRODYNAMICS-THERMODYNAMICS SECTIONS OF THE CODE, TO TRACE THE BLAST WAVE RESULTING FROM THE DETONATION OF A SPHERICAL CHARGE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

MAXIMUM NUMBER OF ENERGY GROUPS	7
MAXIMUM NUMBER OF MASS POINTS	320
MAXIMUM NUMBER OF SUBSTANCES + MIXTURES	8

THE EFFECTS OF DELAYED NEUTRONS AND HEAT TRANSFER ARE COMPLETELY NEGLECTED.
6. TYPICAL RUNNING TIME -
 - (A) VARIES WITH ACCURACY CRITERIA, NUMBER OF MASS POINTS AND NUMBER OF ENERGY GROUPS. A TYPICAL PROBLEM CONSISTING OF 20 REACTOR MASS POINTS, 300 GAS MASS POINTS, AND SIX ENERGY GROUPS TAKES ABOUT 60 MINUTES.

6. TYPICAL RUNNING TIME (CONTINUED)
 - (B) A TYPICAL TNT BLAST-WAVE PROBLEM CONSISTING OF 10 TNT REGIONS AND 29 ARGON REGIONS TAKES ABOUT 30 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - THE AX-TNT PROGRAM IS BASICALLY THE SAME AS THE AX1 PROGRAM WITH THE FOLLOWING MODIFICATIONS,
 - (A) A COMBINATION OF THE CLAUSIUS-CLAPEYRON AND LINEAR EQUATIONS OF STATE ARE USED IN THE REACTOR. GAS REGIONS ENCLOSING THE REACTOR MAKE USE OF AN IDEAL GAS EQUATION OF STATE. A TWO-TEMPERATURE REGION CLAUSIUS-CLAPEYRON EXPRESSION IS USED WITH THE TRIPLE POINT AS THE DIVIDING POINT BETWEEN THE LOW AND HIGH TEMPERATURE EXPRESSION. SEVERAL LINEAR SECTIONS ARE USED TO APPROXIMATE THE HEAT CAPACITY. THE SN CONVERGENCE ON THE FUEL ENRICHMENT HAS BEEN INCORPORATED INTO THE CODE AS WELL AS MODIFICATIONS TO TAKE INTO ACCOUNT DOPPLER CONTRIBUTIONS TO INVERSE PERIOD AND A RAMP INSERTION OF REACTIVITY. THE AX1 CODE HAS BEEN EXPANDED FROM A MAXIMUM OF 40 REGIONS TO 320 REGIONS TO ALLOW INVESTIGATION OF SHOCK WAVES. NEW CONTROL MODIFICATIONS HAVE BEEN INCLUDED TO REDUCE THE INCREASED MACHINE TIME RESULTING FROM THE ADDED REGIONS. MINOR MODIFICATIONS IN THE AX-1 HYDRO-DYNAMIC EQUATIONS ALLOW THE INVESTIGATION OF CENTER HOLE AND IMPLOSION PROBLEMS.
 - (B) USING AN IDEAL GAS EQUATION FOR TNT AND ARGON THE FORMATION, REFLECTION, REFRACTION, AND DECAY OF PRIMARY AND SECONDARY SHOCK WAVES CAN BE STUDIED.
8. RELATED AND AUXILIARY PROGRAMS - THE AX-TNT PROGRAM IS AN EXTENSION OF THE AX1 PROGRAM (ACC ABSTRACT 102). EQUATIONS OF STATE ARE SIMILAR TO THOSE CONSIDERED IN THE RAC CODE. DELAYED NEUTRON EFFECTS CAN BE ACCOUNTED FOR BY USING THE AIREK2 CODE DURING THE BEGINNING OF THE EXCURSION. H. BORDE HAS DESCRIBED A CODE FOR EXAMINING BLAST WAVES FROM A SPHERICAL CHARGE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCES - C. J. ANDERSON, AX-TNT, A CODE FOR THE INVESTIGATION OF REACTOR EXCURSIONS AND BLAST WAVES FROM A SPHERICAL CHARGE, TIM-951, JULY 1965.
D. OKRENT, J. M. COOK, D. SATKUS, R. B. LAZARUS AND M. B. WELLS, AX-1, A COMPUTER PROGRAM FOR COUPLED NEUTRONICS-HYDRODYNAMICS CALCULATIONS ON THE IBM704, ANL-5977, MAY 1959.
CURTIS G. CHEZEN AND WILLIAM R. STRATTON, RAC-A COMPUTER CODE FOR REACTOR ACCIDENT CALCULATIONS, LAMS-2920, JANUARY 1963.
A. SCHWARTZ, GENERALIZED REACTOR KINETICS CODE AIREK II, NAA-SR-MEMO 4980, FEBRUARY 1960.

10. REFERENCES (CONTINUED)
HAROLD L. BORDE, BLAST WAVE FROM A SPHERICAL CHARGE,
PHYSICS OF FLUIDS, 2, 2, PP. 217-229, APRIL 1959.
11. MACHINE REQUIREMENTS - 32K MEMORY, 1 MAGNETIC TAPE UNIT
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD CONTROL DATA COOP MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
W. J. FADER AND C. J. ANDERSON
PRATT AND WHITNEY AIRCRAFT - CANEL
MIDDLETOWN, CONNECTICUT
16. MATERIAL AVAILABLE -
SOURCE DECK (822 CARDS)
SAMPLE PROBLEM (492 CARDS)
REFERENCE REPORT, TIM-951
17. CATEGORY - F
KEYWORDS - HYDRODYNAMICS, SN METHOD, THERMODYNAMICS, EXCURSIONS,
SPHERES, GASES

REACTOR CODE ABSTRACT 192

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1. NAME OR DESIGNATION OF PROGRAM - 2DXYL
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE 2DXY PROGRAM (ACC ABSTRACT 18) HAS BEEN CONVERTED FROM FLOCO TO FORTRAN 63 FOR USE ON THE CDC1604 WITH CHANGES TO PERMIT THE INCLUSION OF FIXED SOURCE TERMS FROM TDC - TERMS REPRESENTING THE EFFECTIVE NET LOSS PER UNIT VOLUME DUE TO AXIAL LEAKAGE. IN THIS MANNER, A THREE-DIMENSIONAL FLUX SYNTHESIS CODE IS ACHIEVED.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - A 400 POINT MESH AND 16 ENERGY GROUP PROBLEM REQUIRED 46 MINUTES (EXCLUDING THE PRELIMINARY TDC CALCULATION REQUIRED).
7. UNUSUAL FEATURES OF THE PROGRAM - AN ACCURATE CALCULATION OF VARIOUS REFLECTOR CONFIGURATIONS HAS BEEN PERFORMED FOR A CYLINDRICAL FINITE REACTOR BY COUPLING 2DXY AND TDC.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCES - J. BENGSTON, S. T. PERKINS, T. W. SHEHEEN, AND O. W. THOMPSON - 2DXY, TWO DIMENSIONAL CARTESIAN COORDINATE SN TRANSPORT CALCULATION, AGN TM-392, JUNE 1961.
CARL KELLER, 2DXYL USERS GUIDE, PRATT AND WHITNEY AIRCRAFT-CANEL, TIM-935, JULY 7, 1965.
W. J. FADER, R. J. RODGERS, F. R. MYNATT, AND R. E. LAWRENCE, THE TDC CODE, TIM-847, SEPTEMBER 1964.
11. MACHINE REQUIREMENTS - 32K STORAGE, INPUT AND OUTPUT TAPE UNITS
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD CDC COOP MONITOR SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - DATA STORAGE MAY NOT EXCEED 22,000 DECIMAL LOCATIONS.
15. NAME AND ESTABLISHMENT OF AUTHORS -
R. J. RODGERS AND C. E. KELLER
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2749 CARDS)
REFERENCE REPORT, TIM-935
17. CATEGORY - C
KEYWORDS - SN METHOD, 2-DIMENSIONAL, MULTIGROUP, X-Y, 3-DIMEN-
SIONAL FLUX SYNTHESIS

REACTOR CODE ABSTRACT 193

10/67

1. NAME OR DESIGNATION OF PROGRAM - CSP2A
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS CODE PREPARES 100 GROUP FORWARD AND ADJOINT MACROSCOPIC MIXTURE CROSS SECTIONS FOR SN TYPE CODES. THE 100 GROUP MICROSCOPIC CROSS SECTIONS ARE TAKEN FROM THE CROSS SECTION TAPE WRITTEN BY THE CODE CSP1. THE OUTPUT OF CSP2A IS IN THE FORM OF TWO TAPES, ONE CONTAINING THE FORWARD AND THE OTHER THE ADJOINT MACROSCOPIC CROSS SECTIONS. THE CROSS SECTIONS ARE ALSO PRINTED, IF DESIRED.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - APPROXIMATELY 20 SECONDS PER NUCLIDE.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - CSP1 (ACC ABSTRACT 194) AND MGDSN-A MODIFICATION OF DSN TO ACCOMMODATE 100 GROUP ISOTROPIC CROSS SECTION DATA TAPES, (ACC ABSTRACT 211).
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCES - G. D. JOANOU AND J. S. DUDEK, GAM-II, A B3 CODE FOR THE CALCULATION OF FAST-NEUTRON SPECTRA AND ASSOCIATED MULTIGROUP CONSTANTS, GA-4265, SEPTEMBER 13, 1963.
J. A. LOFFREDA AND R. J. CACCIAPOUTI, CSP2A, A CODE FOR PREPARING 100 GROUP FORWARD AND ADJOINT MACROSCOPIC CROSS SECTIONS FOR SN CODES, TIM-931, JULY 12, 1965.
R. J. RODGERS, MGDSN, MANY GROUP DSN, TIM-938, JULY 16, 1965.
11. MACHINE REQUIREMENTS - INPUT AND OUTPUT UNITS PLUS 3 TAPE UNITS, APPROXIMATELY 20,000 MEMORY LOCATIONS
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - COOP.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. J. CACCIAPOUTI
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT

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16. MATERIAL AVAILABLE -
SOURCE DECK (200 CARDS)
REFERENCE REPORTS, TIM-931 AND TIM-938
17. CATEGORY - L
KEYWORDS - CROSS SECTIONS, INPUT DATA PREPARATION, SN METHOD

REACTOR CODE ABSTRACT 194

10/67

1. NAME OR DESIGNATION OF PROGRAM - CSP1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS CODE PREPARES 100 GROUP MICROSCOPIC CROSS SECTIONS FOR SN TYPE REACTOR CODES, USING THE GAM2 NUCLEAR DATA TAPE FOR THE CROSS SECTION DATA FOR THE FIRST 99 GROUPS. THE DATA FOR GROUP 100 IS PART OF THE PUNCHED CARD INPUT. THE 100 GROUP SN CROSS SECTIONS, PREPARED BY THE CODE, ARE WRITTEN ON TAPE AND PRINTED, IF DESIRED. THE CROSS SECTIONS ARE FOR THE ISOTROPIC OPTION OF THE SN CODES. THE DIAGONAL TRANSPORT APPROXIMATION HAS BEEN USED IN CALCULATING THE TRANSPORT AND IN-GROUP SCATTERING CROSS SECTIONS. THE CORRECTION TERM USED TO CALCULATE THESE TWO CROSS SECTIONS IS SIMPLY $1/3$ OF THE P1 SCATTERING CROSS SECTION. THE NUMBER OF OUT-OF-GROUP SCATTERING TERMS IS OPTIONAL. WHEN LESS THAN THE NUMBER APPEARING ON THE GAM2 TAPE ARE REQUESTED, THE REMAINING TERMS, FOR A GIVEN SOURCE GROUP, ARE SUMMED AND ADDED TO THE LAST DOWN-SCATTERING TERM SAVED. WHEN CROSS SECTIONS ARE LISTED IN THE SN FORMAT, IT IS POSSIBLE THAT ONE OR MORE INTERMEDIATE DOWN-SCATTERING TERMS WILL BE ZERO. WHEN THIS SITUATION ARISES, THE CODE WILL REPLACE THESE INTERMEDIATE ZEROS WITH THE QUANTITY $1.0 \times 10^{+(-20)}$.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - APPROXIMATELY ONE MINUTE PER NUCLIDE.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - CSP2A (ACC ABSTRACT 193) ADJOINT CROSS SECTION TAPE PREPARATION CODE. MGDSN-MODIFICATION OF DSN TO ACCOMMODATE 100 GROUP ISOTROPIC CROSS SECTION DATA TAPES, (ACC ABSTRACT 211).
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCES - G. D. JOANOU AND J. S. DUDEK, GAM-II, A B3 CODE FOR THE CALCULATION OF FAST-NEUTRON SPECTRA AND ASSOCIATED MULTIGROUP CONSTANTS, GA-4265, SEPTEMBER 13, 1963.
J. A. LOFFREDA AND R. J. CACCIAPOUTI, CSP1, A CODE FOR PREPARING 100 GROUP CROSS SECTIONS FOR SN CODES, TIM-930, JULY 12, 1965.
R. J. RODGERS, MGDSN, MANY GROUP DSN, TIM-938, JULY 16, 1965.
11. MACHINE REQUIREMENTS - INPUT AND OUTPUT UNITS PLUS 2 TAPE UNITS. APPROXIMATELY 20,000 MEMORY LOCATIONS

12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
COOP.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. J. CACCIAPOUTI
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT
16. MATERIAL AVAILABLE -
SOURCE DECK (274 CARDS)
REFERENCE REPORTS, TIM-930 AND TIM-938
17. CATEGORY - L
KEYWORDS - CROSS SECTIONS, INPUT DATA PREPARATION, SN METHOD, GAM2
CODES, LIBRARIES

REACTOR CODE ABSTRACT 195

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1. NAME OR DESIGNATION OF PROGRAM - FORTRAN FMC-N/FMC-G
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B, IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE FLEXIBLE MONTE CARLO PROGRAMS FMC-N AND FMC-G WERE ORIGINALLY WRITTEN IN ASSEMBLY LANGUAGE FOR THE IBM704 BY GE-ANP. THESE PROGRAMS HAVE BEEN CONVERTED TO FORTRAN FOR THE CDC1604B BY PRATT AND WHITNEY. THE PROGRAMS APPLY MONTE CARLO METHODS TO SIMULATE NEUTRON AND GAMMA RAY LIFE HISTORIES, RESPECTIVELY, IN A SOURCE-SHIELD CONFIGURATION. AS THE NAMES IMPLY, THE CODES ARE DESIGNED FOR FLEXIBILITY IN THE GEOMETRICAL, MATERIAL, NUCLEAR, AND SOURCE DESCRIPTIONS OF SOURCE-SHIELD CONFIGURATIONS AND VARIANCE REDUCTION TECHNIQUES.
4. METHOD OF SOLUTION - ANY NUMBER OF REGIONS OF A VARIETY OF GEOMETRICAL SHAPES ARE ENCLOSED BY ANY NUMBER OF SURFACES DESCRIBED BY

$$A*X**2 + X(0)*X + B*Y**2 + Y(0)*Y + C*Z**2 + Z(0)*Z - K = 0$$
 EACH REGION IS COMPOSED OF A HOMOGENEOUS MIXTURE OF MATERIALS DESCRIBED BY INPUT DATA. ENERGY GROUPS ARE DEFINED BY ENERGY BOUNDS AND MUST REMAIN CONSTANT FOR ALL MATERIALS. NEUTRON ANGULAR DISTRIBUTIONS AFTER ELASTIC AND INELASTIC SCATTERING MAY BE ANISOTROPIC IF THE INCIDENT ENERGY EXCEEDS A SPECIFIED MINIMUM. CUMULATIVE PROBABILITY DISTRIBUTION TABLES ARE USED FOR ANISOTROPIC SCATTERING ANGULAR DISTRIBUTIONS, FISSION NEUTRON ENERGIES, GAMMA RAY ENERGIES AND ANGULAR DISTRIBUTIONS. THE ENERGY OF A NEUTRON AFTER INELASTIC SCATTERING IS COMPUTED FROM NUCLEAR EXCITATION PROBABILITY TABLES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 1 TO 5 HOURS ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM - A RESTART PROCEDURE HAS BEEN INCORPORATED TO ALLOW A RUN TO BE BROKEN DOWN INTO SHORTER RUNS. AN INPUT OPTION ALLOWS THE CONTINUED USE OF A SINGLE HISTORY TALLY TAPE.
8. RELATED AND AUXILIARY PROGRAMS - THERE ARE FIVE AUXILIARY PROGRAMS USED TO PREPARE INPUT -
 - LUX - APPROXIMATES THE ENERGY DEPENDENCE OF THE CROSS SECTION FOR A SPECIFIED EVENT BY A STRAIGHT LINE. (B519)
 - GAD - A PROGRAM FOR AVERAGING DIFFERENTIAL SCATTERING CROSS SECTIONS. (B520)
 - GAMGAD - SPECIAL GAD VERSION TO PREPARE ANGULAR DISTRIBUTION TABLES FOR FMC-G. INSTEAD OF READING IN CROSS SECTIONS THE KLEIN-NESHINA FORMULAS ARE USED.
 - STEM - PREPARES SPECTRUM TABLES FROM EVAPORATION MODEL. (B521)

8. RELATED AND AUXILIARY PROGRAMS (CONTINUED)
NEAT - COMPUTES NUCLEAR EXCITATION AND TRANSIENT PROBABILITIES FROM MEASURED GAMMA-RAY INTENSITIES. (B522)
FORED - SCATTER LOAD SUBROUTINE USED WITH LUX, GAD, AND STEM. IN ADDITION THE TWO ROUTINES PREP-N AND PREP-G READ IN THE INPUT FOR FMC-N AND FMC-G RESPECTIVELY, PERFORM CHECKS, COMPUTE SOURCE PARTICLE COORDINATES AND SET ASIDE BLOCKS FOR INPUT AND OUTPUT ARRAYS.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
COC1604 VERSION SUBMITTED JULY 1965.
IBM7044 VERSION SUBMITTED OCTOBER 1967.
10. REFERENCES - J. J. LOECHLER AND J. E. MACDONALD, FLEXIBLE MONTE CARLO PROGRAMS FMC-N AND FMC-G, APEX-706, APRIL 28, 1961.
E. E. KINNEY, MONTE CARLO CODES, FMC-N AND FMC-G, TIM-941, JULY 22, 1965.
E. E. KINNEY, MONTE CARLO DATA PREPARATION CODES, TIM-806, FEBRUARY 20, 1964.
J. P. YALCH AND J. E. MACDONALD, PROGRAM 20-4, A PROGRAM FOR AVERAGING DIFFERENTIAL SCATTERING CROSS SECTIONS, GEMP-115, JUNE 1962.
11. MACHINE REQUIREMENTS - 6 TAPES AND ON-LINE PRINTER
12. PROGRAMMING LANGUAGES USED - FORTRAN 63 WITH TWO CODAP SUBROUTINES SETPANIC, A ROUTINE TO ALLOW 10 MINUTES TO OUTPUT DATA AND GENERATE A NEW INPUT TAPE AFTER JOB TIME HAS ELAPSED OR AN ERROR OCCURRED, AND YELL, A ROUTINE TO PRODUCE A TONE LOOP WHEN AN END OF TAPE IS ENCOUNTERED.
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - COOP.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - BUFFER IN AND BUFFER OUT STATEMENTS ARE USED FOR READING AND WRITING TAPES.
15. NAME AND ESTABLISHMENT OF AUTHORS -
COC1604 E. E. KINNEY
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT

IBM7044 GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (8066 CARDS)
SOURCE DECKS (16048 FMC-N/FMC-G 6226 CARDS, LUX 263 CARDS,
GAD 342 CARDS, GAMGAD/STEM/FORED 439 CARDS,
NEAT 86 CARDS, 7044 FMC-N 3828 CARDS)
SAMPLE PROBLEMS (16048 FMC-N/FMC-G 580 CARDS, LUX 61 CARDS,
GAD 54 CARDS, GAMGAD/STEM/FORED 14 CARDS,
NEAT 6 CARDS, 7044 FMC-N 441 CARDS)
REFERENCE REPORTS
17. CATEGORY - 8
KEYWORDS - MONTE CARLO METHOD, CELL CALCULATION, NEUTRONS, GAMMA
RADIATION, SHIELDING, LUX CODES, GAD CODES, GAMGAD
CODES, STEM CODES, NEAT CODES, FORCED CODES

1. NAME OR DESIGNATION OF PROGRAM - CURIE/DOSE/THUNDERHEAD
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - CURIE CALCULATES THE FISSION PRODUCT INVENTORY PRODUCED IN A REACTOR DURING CONSTANT POWER OPERATION AND RELEASES DIFFERENT PERCENTAGES OF THE NOBLE GASES, HALOGENS, AND PARTICULATES TO THE ATMOSPHERE AT REACTOR SHUTDOWN. DOSE CALCULATES THE TOTAL DOSE TO 13 INTERNAL BODY ORGANS RESULTING FROM INHALATION OF THE PASSING RADIOACTIVE CLOUD. THUNDERHEAD CALCULATES THE EXTERNAL CLOUD GAMMA EXPOSURE DOSE FROM THE RELEASED FISSION PRODUCTS.
4. METHOD OF SOLUTION - DIFFERENTIAL EQUATIONS RELATING THE NUMBER OF ATOMS OF A FISSION PRODUCT PRODUCED TO THE REACTOR POWER AND OPERATING TIME ARE SOLVED. THE SAME EQUATIONS ARE SOLVED REPEATEDLY AFTER REACTOR SHUTDOWN WITH THE POWER SET EQUAL TO ZERO AND THE OPERATING TIME REPLACED BY THE DECAY TIME, OR TIME SINCE REACTOR SHUTDOWN. THE PARTICULAR FRACTION OF THE FISSION PRODUCT INVENTORY RELEASED TO THE ATMOSPHERE AT REACTOR SHUTDOWN IS ALLOWED TO DRIFT DOWNWIND AT THE AVERAGE WIND SPEED WHILE DIFFUSING IN THE OFF-AXIS AND VERTICAL DIRECTIONS AS DETERMINED BY THE SUTTON ATMOSPHERIC DIFFUSION EQUATION. A RECEPTOR LOCATED DOWNWIND INHALES A PORTION OF THE PASSING RADIOACTIVE CLOUD AND RECEIVES A SMALL DOSE TO EACH INTERNAL BODY ORGAN FROM THE ISOTOPES INHALED. THE TOTAL DOSE IS THE SUM OF THE INDIVIDUAL DOSES. THE EXTERNAL CLOUD GAMMA EXPOSURE DOSE IS OBTAINED BY CONSIDERING THE CLOUD TO BE AN EXPANDING ECLIPSE OF UNIT THICKNESS WHOSE SEMI-MAJOR AND SEMI-MINOR AXIS ARE DETERMINED BY THE HORIZONTAL AND VERTICAL ATMOSPHERIC DIFFUSION PARAMETERS, $C(Y)$ AND $C(Z)$, RESPECTIVELY. THIS CLOUD ACTIVITY IS DISTRIBUTED THROUGHOUT THE CLOUD AS SEVERAL UNSHIELDED POINT SOURCES. THE CLOUD IS POSITIONED BY THE CODE AND THE INCREMENTAL DOSE RATE FROM EACH SOURCE DETERMINED. THIS IS REPEATED FOR SEVERAL CLOUD POSITIONS AND THE TOTAL EXTERNAL CLOUD EXPOSURE DOSE OBTAINED BY GAUSSIAN INTEGRATION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - DECAY TIMES SHOULD BE ENTERED IN ASCENDING ORDER WITH THE FIRST TIME BEING 0 SECONDS IF A RECEPTOR POSITION FOR THUNDERHEAD IS LESS THAN 300 METERS DOWNWIND OF THE RELEASE POINT. THE LAST DECAY TIME SHOULD REPRESENT A CLOUD POSITION AT LEAST 300 METERS DOWNWIND OF ANY OF THE RECEPTOR POINTS.
6. TYPICAL RUNNING TIME - FIVE MINUTES FOR 17 DECAY TIMES.
7. UNUSUAL FEATURES OF THE PROGRAM - DIFFERENT PERCENTAGES OF NOBLE GASES, HALOGENS, CESIUM, AND THE REST OF THE PARTICULATES, RESPECTIVELY, MAY BE RELEASED AT REACTOR SHUTDOWN. VARIABLE POWER HISTORIES MAY BE APPROXIMATED BY REPLACING THE ACTUAL HISTORY WITH

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7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
A SERIES OF STEP-FUNCTIONS AND CONSIDERING THE SHUTDOWN FISSION
PRODUCT INVENTORY OF ONE STEP TO BE THE INITIAL INVENTORY OF THE
NEXT ONE. THE RECEPTOR CAN BE LOCATED ANYWHERE DOWNWIND IN DOSE
AND ANYWHERE IN SPACE IN THUNDERHEAD.
8. RELATED AND AUXILIARY PROGRAMS - THUNDERHEAD BY ITSELF UTILIZING
THE SUTTON ATMOSPHERIC DIFFUSION PARAMETERS OR THE PASQUILL
DIFFUSION THEORY.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7094 VERSION SUBMITTED AUGUST 1965.
10. REFERENCES - G. P. KENFIELD, W. R. LAHS, W. B. SAYER, R. H.
MACADAMS, N. A. HARRIS, CURIE-DOSE-THUNDERHEAD - A DIGITAL
COMPUTER PROGRAM FOR EXTERNAL AND INTERNAL RADIATION DOSE
CALCULATIONS, NAA-SR-8884, JUNE 1965, AND ERRATA.
INTERNAL LETTER 930-24, LIBRARY DESCRIPTION, SEPTEMBER
30, 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGES USED - FORTRAN II (75 PERCENT)
FAP (25 PERCENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD IBM FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
G. P. KENFIELD
SENIOR ENGINEER
KINETICS AND SAFETY UNIT
ATOMICS INTERNATIONAL
P. O. BOX 309,
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (5066 CARDS)
SOURCE DECK
SAMPLE PROBLEM
LIBRARY DATA
REFERENCE REPORT AND LETTER
17. CATEGORY - G
KEYWORDS - FISSION PRODUCTS, DOSE RATES, RADIOACTIVITY, ATMO-
SPHERE, CONTINUOUS RELEASE

1. NAME OR DESIGNATION OF PROGRAM - SHOE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE SHOE CODE MAKES USE OF THE METHOD OF STEEPEST DESCENT TO FIND THE DIMENSIONS OF A MINIMUM-WEIGHT, THREE-LAYER SHIELD IN SPHERICAL GEOMETRY. THE WEIGHT MINIMIZATION IS CARRIED OUT SUBJECT TO THE CONSTRAINING CONDITION OF A CONSTANT DOSE RATE AT SOME SELECTED POINT OUTSIDE THE SHIELD.
4. METHOD OF SOLUTION - THE COMPUTED DOSE RATE IS THE SUM OF THE NEUTRON AND GAMMA RAY CONTRIBUTIONS. NEUTRON FLUXES ARE COMPUTED IN THE SHIELD USING TWO GROUP DIFFUSION THEORY AND THE DOSE RATE AT THE DOSE POINT IS THEN PROPORTIONAL TO THE NEUTRON FLUX AT THE OUTER SHIELD RADIUS. GAMMA RAY SOURCES COME UNDER TWO CATEGORIES - SOURCES OF PHOTONS IN THE CORE AND SOURCES OF SECONDARY PHOTONS GENERATED IN THE SHIELD ITSELF. THE CORE SOURCE IS REPRESENTED BY A POINT SOURCE LOCATED AT THE CORE ORIGIN. THE NUMBER OF PHOTONS PER SECOND LEAVING THE CORE IN EACH ENERGY GROUP MUST BE SPECIFIED. THE DOSE DUE TO SECONDARY GAMMAS IS FOUND BY INTEGRATING A POINT SOURCE KERNEL OVER THE SHIELD SYSTEM.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE CODE IS PRESENTLY SET UP TO HANDLE 12 GAMMA ENERGY GROUPS.
6. TYPICAL RUNNING TIME - MOST CASES OF INTEREST HAVE RUN IN 20 TO 50 SECONDS ON THE IBM7094.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7094 VERSION SUBMITTED SEPTEMBER 1965.
10. REFERENCES - R. L. BERNICK, APPLICATION OF THE METHOD OF STEEPEST DESCENT TO LAMINATED SHIELD WEIGHT OPTIMIZATION, NAA-SR-TDR-8181.
R. L. BERNICK, SHOE - A SHIELD WEIGHT OPTIMIZATION CODE, NAA-SR-TDR-10922, JANUARY 15, 1965.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

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15. NAME AND ESTABLISHMENT OF AUTHOR -

W. B. GREEN
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA

16. MATERIAL AVAILABLE -

SOURCE DECK (1854 CARDS)
SAMPLE PROBLEM (25 CARDS)
REFERENCE REPORT, NAA-SR-MEMO 10922

17. CATEGORY - J

KEYWORDS - DIFFUSION EQUATIONS, 2-GROUP, DOSE RATES, NEUTRONS,
GAMMA RADIATION, SHIELDING

1. NAME OR DESIGNATION OF PROGRAM. - HEATING2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - HEATING2 IS A GENERALIZED HEAT TRANSFER CODE CAPABLE OF SOLVING TRANSIENT AND/OR STEADY-STATE COORDINATE SYSTEMS. THE SIMPLIFIED INPUT MAKES IT A VERY USEFUL CODE FOR THOSE PROBLEMS HAVING GEOMETRICAL CONFIGURATIONS WHICH CAN BE DESCRIBED BY PARALLEL AND PERPENDICULAR LINES OR PLANES, OR CONCENTRIC CIRCLES. THESE FIGURES CAN BE BROKEN UP INTO A MAXIMUM OF 100 ONE-MATERIAL REGIONS WITH POSITION AND TIME-DEPENDENT VOLUMETRIC HEAT GENERATION RATES. UP TO 40 MATERIALS WITH CONSTANT PROPERTIES CAN BE DESCRIBED, AND THE INITIAL TEMPERATURES OF THESE REGIONS ARE POSITION-DEPENDENT. THE BOUNDARIES OF THESE REGIONS CAN BE CONTACT, INSULATED, TIME-DEPENDENT TEMPERATURE CONTROLLED, OR FORCED CONVECTION WITH A TIME-DEPENDENT SINK TEMPERATURE. ALSO A RADIATION BOUNDARY WITH A TIME-DEPENDENT SINK TEMPERATURE IS INCLUDED.
4. METHOD OF SOLUTION - THE NUMERICAL TECHNIQUES USED ARE THE TECHNIQUES DEVELOPED BY T. B. FOWLER AND E. R. VOLK WHICH WERE USED IN THE OAK RIDGE NATIONAL LABORATORY GHT CODE. THE GEOMETRY SECTION WAS ADDED AT ASTRA BY R. R. LIGUORI AND J. W. STEPHENSON AND APPEARED AS THE ORIGINAL HEATING CODE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
750 NODES
100 MATERIAL REGIONS
40 MATERIALS
6. TYPICAL RUNNING TIME - 1 TO 2 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM -
(A) GEOMETRY DESCRIBED BY LATTICE LINES WHICH RESULTS IN A SIMPLIFIED INPUT.
(B) EXTENSIVE PRINTING AND GRAPHICAL DISPLAYS UNDER USER CONTROL.
8. RELATED AND AUXILIARY PROGRAMS - GHT, A GENERALIZED HEAT CONDUCTION CODE FOR THE IBM704 COMPUTER (ORNL-2174).
HEATING (ASTRA 417-5.0).
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7094 VERSION SUBMITTED SEPTEMBER 1965.
10. REFERENCES - R. D. BRUNELL, HEATING AND HEATING 2, AI-64-MEMO-177.
M. HOFFMAN AND W. A. RHOADES, AICRT3, A GENERAL CODE FOR DISPLAY OF DIGITAL DATA, NAA-SR-MEMO-9069, OCTOBER 1963.
11. MACHINE REQUIREMENTS - 32K MEMORY, SC-4020 GRAPHICAL DISPLAY DEVICE

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12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
FIB III.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
IF AN SC-4020 GRAPHICAL DISPLAY IS NOT AVAILABLE, THE AICRT3
DISPLAY ROUTINE CAN BE REWRITTEN - OTHERWISE, CHAIN (4,7) CAN BE
DELETED AND THE CALL TO THIS CHAIN OMITTED. A KIKOFF ROUTINE,
WHICH PRINTS THE LATEST RESULTS WHEN A MACHINE STOP OCCURS, IS
INCLUDED IN HEATING2. THIS ROUTINE CAN BE DELETED IF THE KICKOFF
CAPABILITY IS NOT PRESENT IN THE USERS SYSTEM. THE NAA-SC-4020
(FIB III) SUBROUTINE PACKAGE IS AVAILABLE THROUGH -
VAIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA
15. NAME AND ESTABLISHMENT OF AUTHOR -
A. N. NICKOLS
COMPUTING TECHNOLOGY GROUP
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (1979 CARDS)
SAMPLE PROBLEM (40 CARDS)
REFERENCE REPORTS
17. CATEGORY - H
KEYWORDS - HEAT TRANSFER, GRAPHS, 1-DIMENSIONAL GEOMETRIES

1. NAME OR DESIGNATION OF PROGRAM - TDP
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - TDP IS A TWO-DIMENSIONAL LINEAR PERTURBATION THEORY CODE WHICH CALCULATES REACTIVITY COEFFICIENTS, PROMPT NEUTRON LIFETIMES, AND EFFECTIVE DELAYED FRACTIONS USING FLUXES FROM TDC CYLINDRICAL (R-Z) OR RECTANGULAR (X-Y) GEOMETRY.
4. METHOD OF SOLUTION - THE TDP CALCULATION OF REACTIVITY CHANGES RESULTING FROM MINOR ALTERATIONS OF MATERIAL COMPOSITION IS BASED ON FIRST ORDER PERTURBATION THEORY.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - DATA STORAGE IS LIMITED TO 22,500 LOCATIONS.
6. TYPICAL RUNNING TIME - A 400 MESH AND 16 ENERGY GROUP PROBLEM RUNS IN 3 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - THIS PROGRAM REQUIRES FORWARD AND ADJOINT SCALAR AND ANGULAR FLUXES AS CALCULATED BY THE CANEL TDC AND 2DXY PROGRAMS. FLUXES AS CALCULATED BY OTHER SN CODES SUCH AS DOF CAN ALSO BE USED IF IN THE PROPER INPUT FORMAT.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCES - W. J. FADER, TOP - A TWO DIMENSIONAL PERTURBATION CALCULATION BASED ON TDC, TIM-797, OCTOBER 14, 1964.
C. E. KELLER, USERS GUIDE TO FORTRAN TDP, TIM-797, SUPPLEMENT 1, MARCH 19, 1965.
11. MACHINE REQUIREMENTS - 32K STORAGE AND INPUT AND OUTPUT TAPE UNITS PLUS THREE TAPE UNITS
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - COOP.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
W. J. FADER AND C. E. KELLER
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT

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16. MATERIAL AVAILABLE -
SOURCE DECK (730 CARDS)
REFERENCE REPORTS

17. CATEGORY - C
KEYWORDS - PERTURBATION THEORY, 2-DIMENSIONAL, REACTIVITY, LIFE-
TIME, X-Y, R-Z, MULTIGROUP

1. NAME OR DESIGNATION OF PROGRAM - SATURATED BLOWDOWN1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - CALCULATION OF LOCAL PRESSURES, MASS FLOW RATES, FLUID QUALITIES, SPECIFIC VOLUMES, TEMPERATURES AND LOCAL HEAT TRANSFER COEFFICIENTS AT WETTED WALLS, DURING BLOWDOWN OF THE REACTOR PRIMARY COOLANT LOOP.
4. METHOD OF SOLUTION - THE PRIMARY COOLANT LOOP IS SEGMENTED IN UP TO 53 SEGMENTS. THREE LEVELS OF ITERATIONS ARE PERFORMED FOR THE CALCULATIONS PERTAINING TO EACH TIME INTERVAL. THE FIRST LEVEL INVOLVES THE SOLUTION OF THE MASS, MOMENTUM, AND ENERGY CONSERVATION EQUATIONS, MAKING USE OF STEAM TABLES TO FORMULATE THE EQUATIONS OF STATE FOR THE FLUID. THE SECOND LEVEL OF ITERATIONS ADJUSTS THE FLOWS AT THE BRANCH TEE, WHILE THE THIRD LEVEL ADJUSTS THE FLOW AT THE RUPTURE (EXIT) TO MEET THE CRITICAL FLOW CONDITIONS. TEMPERATURE PROFILES AND HEAT FLUX ARE CALCULATED IN ALL WETTED WALLS AT EACH TIME INCREMENT IN ORDER TO OBTAIN THE HEAT TRANSFER COEFFICIENTS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - UP TO 53 SPATIAL SEGMENTS REPRESENT THE SYSTEM. EACH SEGMENT CAN CONTAIN UP TO 4 DIFFERENT WETTED SURFACES. ALL WETTED SURFACES ARE ASSUMED TO BE SLABS INSULATED ON ONE SIDE, EXCEPT THE REACTOR CORE FUEL ELEMENTS AND THE HEAT EXCHANGER TUBING. THE PUMP HAS NO EFFECT. FLOW REVERSALS CANNOT OCCUR, I.E. THE FLUID MUST ALWAYS FLOW TOWARDS THE BRANCH TEE AND THEN TO THE EXIT. THE FLOW IS INITIALLY AT OR SLIGHTLY BELOW THE SATURATION TEMPERATURE.
6. TYPICAL RUNNING TIME - IT IS A FUNCTION OF THE NUMBER OF LOOP SEGMENTS, THE SPECIFIED END PRESSURE, THE SPECIFIED LENGTHS OF TIME INCREMENTS, AND THE EXIT AREA. UP TO 5 TIME ZONES, EACH TIME ZONE HAVING DIFFERENT TIME INCREMENTS, CAN BE SPECIFIED. TYPICAL RUNNING TIME FOR THE CASE OF A LOOP DIVIDED IN 53 SEGMENTS INITIALLY CONTAINING SATURATED WATER AT 600 DEGREES AND BLOWING DOWN THROUGH A 16 1/2 INCH I.D. EXIT (VALVE), IS 90 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - THIS CODE IS DIVIDED INTO A FAIRLY LARGE NUMBER OF SUBROUTINES AND FUNCTIONS SO THAT MODEL CHANGES CAN EASILY BE INCORPORATED. THE SYSTEM REQUIRES A SPECIFICATION OF A HEAT EXCHANGER, NUCLEAR REACTOR CORE, A PUMP (ASSOCIATED WITH A CHECK VALVE), A BRANCH TEE, AND ONE SO-CALLED DEAD SEGMENT WHICH IS AN OFF-BRANCH OF THE LOOP. TEMPERATURE PROFILES THROUGH THE WETTED SLABS CAN BE PRINTED IF SO DESIRED.

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8. RELATED AND AUXILIARY PROGRAMS - WH58 THERMODYNAMIC PROPERTIES OF WATER AND STEAM, SHARE DIST. 1095.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7094 VERSION SUBMITTED SEPTEMBER 1965.
10. REFERENCES - STANISLAV FABIC, DIGITAL COMPUTER BLOWDOWN ANALYSIS FOR LOSS-OF-FLUID TEST FACILITY, PART 1, ENGINEERING, 65-29-R, MAY, 1965.
THE SERVICE BUREAU CORPORATION, PALO ALTO, CALIFORNIA, DIGITAL COMPUTER BLOWDOWN ANALYSIS FOR LOSS-OF-FLUID TEST FACILITY, PART 2, PROGRAMMING, JULY 19, 1965.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND MAP. MAP IS USED IN STEAM TABLE ROUTINES, ERROR ROUTINES, AND SOME INPUT-OUTPUT ROUTINES.
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - I8JOB, IBSYS VERSION 12.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
S. FABIC
KAISER ENGINEERS
KAISER CENTER
300 LAKESIDE DRIVE
OAKLAND, CALIFORNIA 94604

S. TOGASAKI
THE SERVICE BUREAU CORPORATION
2450 WATSON COURT
PALO ALTO, CALIFORNIA 94303
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (4665 CARDS)
BINARY DECK (11794 CARDS)
SAMPLE PROBLEMS (561 CARDS)
REFERENCE REPORT, PART 1 AND SECTION A, PART 2
17. CATEGORY - G
KEYWORDS - BLOWDOWN, COOLANTS, PRESSURE, TEMPERATURE, FLUID FLOW, HEAT TRANSFER, WH58 CODES

1. NAME OR DESIGNATION OF PROGRAM - EPITHERMOS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE EPITHERMOS CODE IS A MODIFICATION OF THE THERMOS THERMAL TRANSPORT THEORY CODE OF HONECK. THE ESSENTIAL DIFFERENCE BETWEEN THE CODES IS IN THE LIBRARY PREPARATION SUBROUTINE BASK. THE EPITHERMOS CODE IS DESIGNED TO COMPUTE THE NEUTRON DENSITY ABOVE 0.7849 EV, THE MAXIMUM ENERGY OF THE USUAL THERMOS CALCULATION. EPITHERMOS COMPUTES THE SCALAR NEUTRON DENSITY AS A FUNCTION OF POSITION AND SPEED IN A ONE-DIMENSIONAL SLAB OR CYLINDRICAL SYSTEM. THE SCATTERING MODEL IS ARBITRARY IN THE THERMAL RANGE AND THE BUILT-IN FREE GAS MODEL IS USED IN THE EPITHERMAL RANGE.
4. METHOD OF SOLUTION - ESTABLISHES A THREE-DIMENSIONAL MATRIX WHICH TAKES NEUTRONS FROM ONE ELEMENT IN THE SPEED-POSITION SPACE TO ANOTHER ELEMENT IN THE SPACE. ITERATIVE MULTIPLICATION OF THE TRIAL FUNCTION IS CARRIED OUT UNTIL THE PRESELECTED CONVERGENCE CRITERION IS MET.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
30 SPEED GROUPS IN THE THERMAL AND/OR THE EPITHERMAL PART.
20 SPACE POINTS IN THE THERMAL AND/OR THE EPITHERMAL PART.
5 MIXTURES (ASSIGNED ARBITRARILY TO THE SPACE POINTS) COMPOSED OF 10 ISOTOPES. AN ADDITIONAL 10 ISOTOPES CAN BE USED FOR EDITING PURPOSES.
THE RESTRICTIONS APPLY SEPARATELY TO THE FAST AND THERMAL PARTS.
6. TYPICAL RUNNING TIME - APPROXIMATELY $NK \cdot (N+K+5) / 10 \cdot 4$ MINUTES WHERE N IS THE NUMBER OF SPACE POINTS AND K IS THE NUMBER OF GROUPS.
7. UNUSUAL FEATURES OF THE PROGRAM - DESIGNED FOR PRODUCTION RUNNING. LIBRARY TAPE AND/OR ON-LINE CROSS SECTION INPUT. THE EPITHERMAL (EPITHERMOS) AND THERMAL (THERMOS) PROBLEMS MAY BE COUPLED IN THE CASE OF HEAVY (M GREATER THAN 1) MODERATORS BY MEANS OF THE SPATIAL VARIATION OF THE SLOWING DOWN DENSITY TO THERMAL WHICH IS COMPUTED IN EVERY EPITHERMAL RANGE PROBLEM. THE SPATIAL VARIATION OF THE THERMAL SOURCE IS SET EQUAL TO THE SPATIAL VARIATION OF THE SLOWING DOWN DENSITY. THE EPITHERMAL SCATTERING CROSS SECTIONS ARE ALL NORMALIZED TO THE DIFFERENCE BETWEEN THE TOTAL SCATTERING CROSS SECTION AND THE REMOVAL CROSS SECTION WITH THE REMOVAL CROSS SECTIONS EXPLICITLY INCLUDED AS ABSORPTION. THE EDIT INCLUDES NEUTRON BALANCE AND FOIL ACTIVATION DISTRIBUTIONS. ARBITRARY SPACE AND SPEED MESH IS ALLOWED.
8. RELATED AND AUXILIARY PROGRAMS - THERMOS.

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9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7094 VERSION SUBMITTED DECEMBER 1965.
10. REFERENCES - H. C. HONECK, THERMOS, A THERMALIZATION TRANSPORT
THEORY CODE FOR REACTOR LATTICE CALCULATIONS, BNL-5826,
SEPTEMBER 1961.
M. A. ROBKin, PROGRAM FOR THE DEVELOPMENT OF
PLUTONIUM RECYCLE FOR USE IN LIGHT WATER MODERATED REACTORS,
FINAL REPORT, GEAP-4907, AUGUST 15, 1965.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN II (95 PER CENT)
FAP (5 PER CENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
M. A. ROBKin
GENERAL ELECTRIC COMPANY .
VALLECITOS ATOMIC LABORATORY
ATOMIC POWER EQUIPMENT DEPARTMENT
PLEASANTON, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2117 CARDS)
SAMPLE PROBLEM (115 CARDS)
REFERENCE REPORTS
17. CATEGORY - B
KEYWORDS - TRANSPORT THEORY, EPITHERMAL, THERMAL, SPECTRA, LAT-
TICES, SLABS, CYLINDERS, 1-DIMENSIONAL, CROSS SECTIONS,
BASK CODES

1. NAME OR DESIGNATION OF PROGRAM. - MCS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED. - THE MCS CODE DETERMINES THE SPATIAL DISTRIBUTION OF SOME NUCLEAR REACTION FOR A GIVEN NEUTRON SOURCE IN A GIVEN CONFIGURATION OF MATERIALS. THE MONTE CARLO ESTIMATE OF THE SOLUTION CONSISTS OF PICKING A SAMPLE OF NEUTRONS FROM THE GIVEN SOURCE AND FOLLOWING EACH NEUTRON THROUGH A SEQUENCE OF SURFACE CROSSINGS AND COLLISIONS UNTIL THE NEUTRON EITHER ESCAPES OR IS NO LONGER OF INTEREST TO THE SOLUTION. THE DESIRED FLUX OR COLLISION DENSITY IS ACCUMULATED FOR EVERY NEUTRON OF THE SAMPLE, AND THE SAMPLE SIZE INCREASED UNTIL RESULTS OF SUFFICIENT STATISTICAL SIGNIFICANCE ARE OBTAINED.
4. METHOD OF SOLUTION - THE CODE IS DESIGNED TO HANDLE AN ARBITRARY 3-DIMENSIONAL CONFIGURATION OF FIRST-AND SECOND-DEGREE SURFACES. THE REGION OF SPACE UNDER CONSIDERATION IS SUBDIVIDED BY THESE SURFACES INTO A NUMBER OF CELLS, IN EACH OF WHICH THE MATERIAL PROPERTIES - ISOTOPES COMPOSITION AND DENSITY - AND THE NEUTRON IMPORTANCE ARE ASSUMED CONSTANT. THE ELASTIC SCATTERING DISTRIBUTION AT EACH ENERGY IS DEFINED EITHER BY A SET OF TABULATED VALUES AT $\cos \alpha$ (IN) AND LINEAR INTERPOLATION OR BY A POLYNOMIAL FIT IN $\cos \alpha$. IN THE EVENT THAT THE NEUTRON IS INELASTICALLY SCATTERED, THE ANGLE OF SCATTERING AND FINAL ENERGY DEPEND ON THE TYPE OF NUCLEAR REACTION. TO IMPROVE EFFICIENCY SEVERAL VARIANCE-REDUCING FEATURES HAVE BEEN INCLUDED- CENTRAL TO ALL IS THE WEIGHT CONCEPT.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM. - ALLOWANCE HAS BEEN MADE FOR AT MOST 432 SURFACES AND 2048 CELLS.
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM. -
8. RELATED AND AUXILIARY PROGRAMS - MCA-READS DATA CARDS PREPARED IN A SIMPLIFIED FORMAT, STORES THE VARIOUS QUANTITIES IN THE FORM AND LOCATIONS REQUIRED, PERFORMS INPUT CONSISTENCY CHECKS, WRITES DATA ON TAPE FOR MCS, AND LISTS DATA FOR PROBLEM ORIGINATOR.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7090 VERSION SUBMITTED DECEMBER 1965.
10. REFERENCE - ROBERT R. JOHNSTON, A GENERAL MONTE CARLO NEUTRONICS CODE, LAMS-2856, MAY 13, 1963.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FLOCO

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13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
TWO VERSIONS OF THE FLOCODE (FORMULA 800) EXIST DIFFERING IN THE
DATA THEY ACCUMULATE -
FC1 - FOR COMPUTING FLUXES OR COLLISION DENSITIES IN A SMALL
NUMBER OF CELLS.
FC2 - FOR OBTAINING THE COLLISION DENSITY IN EVERY CELL, USEFUL
FOR STUDYING REACTION DENSITIES.
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. R. JOHNSTON
LOS ALAMOS SCIENTIFIC LABORATORY
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO 87544
16. MATERIAL AVAILABLE -
SOURCE DECKS AND SAMPLE PROBLEM (543 CARDS)
SAMPLE PROBLEM DESCRIPTION
REFERENCE REPORT
MEMORANDUM, CHANGES IN THE MONTE CARLO CODE
17. CATEGORY - B
KEYWORDS - MONTE CARLO METHOD, NEUTRONS, 3-DIMENSIONAL, CELL CAL-
CULATION, FLUX DISTRIBUTION, REACTION RATES, MCA CODES,
FC1 CODES, FC2 CODES

1. NAME OR DESIGNATION OF PROGRAM - COMBCO (40.0279)
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7040
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PROGRAM PERMITS COMPUTING AND CONVOLUTING A COMBINATION CROSS SECTION CURVE COMPOSED OF THE CROSS SECTION CURVES OF A SAMPLE AND UP TO FOUR CONTAMINANTS.
4. METHOD OF SOLUTION - THE CODE COMPUTES A THEORETICAL CROSS SECTION CURVE MADE UP OF THE COMBINED CURVES OF EACH ISOTOPE FOR WHICH DATA IS PROVIDED. THE CURVES MAY BE COMPUTED USING EITHER THE BREIT-WIGNER SINGLE-LEVEL FORMULA OR THE REICH-MOORE MULTI-LEVEL FORMULA. FISSION CROSS SECTION CURVES ARE COMBINED BY ADDING POINT-BY-POINT AND THEN CONVOLUTING THEM. TOTAL CROSS SECTION CURVES ARE DOPPLER-BROADENED SEPARATELY. THE $N(1)$ SIGMA (1) VALUES ARE THEN ADDED POINT-BY-POINT AND THE RESULTING CURVE CONVERTED INTO A TRANSMISSION CURVE AND RESOLUTION-BROADENED. CONVOLUTION IS ACCOMPLISHED BY NUMERICAL INTEGRATION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - IT IS POSSIBLE TO PROCESS UP TO 5 ISOTOPES PER RUN WITH UP TO 50 RESONANCES PER ISOTOPE.
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - THIS CODE REPLACES AN EARLIER CODE BY THE SAME AUTHOR - MLCNVL (100-17042).
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7040 VERSION SUBMITTED JANUARY 1966.
10. REFERENCE - NELDON H. MARSHALL, COMBCO, COMBINATION BREIT-WIGNER, MULTILEVEL CONVOLUTION PROGRAM, PROGRAM DESCRIPTION, PPCD 40.0279, AUGUST 1964.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
N. H. MARSHALL
PHILLIPS PETROLEUM COMPANY
IDAHO-FALLS, IDAHO

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16. MATERIAL AVAILABLE -
SOURCE DECK (1107 CARDS)
SAMPLE PROBLEM (16 CARDS)
REFERENCE PROGRAM DESCRIPTION
17. CATEGORY - A
KEYWORDS - CROSS SECTIONS, DOPPLER BROADENING, BREIT-WIGNER FORMULA, MULTI-LEVEL, 40.0279 CODES

1. NAME OR DESIGNATION OF PROGRAM - AGN-GAM
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - AGN-GAM CALCULATES THE SUBGROUP FLUXES AND CURRENT TERMS FROM A SOLUTION OF THE P1 OR B1 EQUATIONS. THE P1 EQUATIONS INCORPORATE BOTH VOLUME AND SURFACE SOURCES, ALLOWING SPECTRAL CALCULATIONS IN REFLECTOR REGIONS. OTHER SPECTRAL OPTIONS ARE FLUX KNOWN, CURRENT TERM CALCULATED AND BOTH FLUX AND CURRENT TERMS KNOWN. THE AGE FOR THE MATERIAL IS OBTAINED FROM A SECOND MOMENTS CALCULATION. THE 75 SUBGROUPS USED IN THE CALCULATIONS ARE ESTABLISHED AS QUARTER LETHARGY GROUPS FROM 10 MEV TO 0.07EV. ELASTIC SCATTERING MATRICES MAINTAIN THE ENERGY-ANGLE CORRELATION BY INCLUDING BOTH P0 AND P1 TERMS. ISOTROPIC SCATTERING MATRICES ARE INCLUDED FOR INELASTIC AND (N,2N) PROCESSES. THE METHOD OF ADLER, HINMAN AND NORDHEIM IS USED TO CALCULATE RESONANCE ABSORPTION AND FISSION CROSS SECTIONS. MULTIGROUP CONSTANTS ARE GENERATED BY SPECTRAL AVERAGING OVER THE SUBGROUPS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - 32 FAST GROUPS, 33 GROUPS DOWN SCATTER, IN THE OUTPUT MATRICES.
6. TYPICAL RUNNING TIME - ONE MINUTE.
7. UNUSUAL FEATURES OF THE PROGRAM - PUNCHED OUTPUT FOR LOS ALAMOS SN CODES, ZOOM, PDQ, AIM6, ANGIE, ETC.
8. RELATED AND AUXILIARY PROGRAMS - POP1 - GENERATES P0 AND P1 ELASTIC SCATTERING MATRICES. INSECT - GENERATES INELASTIC SCATTERING MATRIX. SCRIBBLE - MIXES ELEMENTS, EDITS, AND UPDATES THE LIBRARY TAPE. THE LIBRARY TAPE CURRENTLY INCLUDES RESONANCE TABLES FOR SPHERICAL, CYLINDRICAL AND SLAB GEOMETRIES, 10 SOURCE SPECTRA, AND NUCLEAR CROSS SECTION DATA FOR 182 MATERIALS. GAM1 - A CONSISTENT P1 MULTIGROUP CODE FOR THE CALCULATION OF THE FAST NEUTRON SPECTRUM AND MULTIGROUP CONSTANTS, (GA-1850), ACC ABSTRACT 33.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7090 VERSION SUBMITTED OCTOBER 1965.
10. REFERENCE - T. P. WILCOX AND S. T. PERKINS, AGN-GAM, AN IBM 7090 CODE TO CALCULATE SPECTRA AND MULTIGROUP CONSTANTS, AGN-TM-407, APRIL 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY WITH 6 TAPE UNITS
12. PROGRAMMING LANGUAGE USED - FORTRAN 11

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13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD IBM FORTRAN II MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
T. P. WILCOX AND S. T. PERKINS
AERJET-GENERAL NUCLEONICS
P. O. BOX 77
SAN RAMON, CALIFORNIA 94583
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
(2 FILES - 1-4502 CARDS, 2-1414 CARDS)
SOURCE DECKS INCLUDING SCRIBBLE, INSECT, POPI (3506 CARDS)
OBJECT DECKS (968 CARDS)
SAMPLE PROBLEM (24 CARDS)
LIBRARY TAPE (FILE 2)
REFERENCE REPORT
17. CATEGORY - B
KEYWORDS - FAST NEUTRONS SPECTRA, MULTIGROUP GROUP CONSTANTS,
SLOWING DOWN, CROSS SECTIONS, PL METHOD, BL METHOD,
SCRIBBLE CODES, INSECT CODES, POPI CODES

1. NAME OR DESIGNATION OF PROGRAM - BLOOST5
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - BLOOST5 COMBINES A REACTOR KINETICS CODE WITH A TWO-DIMENSIONAL HEAT TRANSFER CODE, AND IS APPLICABLE TO PROBLEMS FOR WHICH THE SPACE-INDEPENDENT FORM OF THE REACTOR KINETICS EQUATION IS APPLICABLE.
4. METHOD OF SOLUTION - A FOURTH ORDER RUNGE-KUTTA INTEGRATION IS USED FOR THE KINETICS EQUATION. A PEACEMAN-RACHFORD ITERATION SCHEME IS EMPLOYED TO SOLVE THE TWO-DIMENSIONAL TIME-DEPENDENT HEAT CONDUCTION EQUATION IN R-Z GEOMETRY.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - TWO-DIMENSIONAL HEAT-TRANSFER ROUTINES ARE LIMITED TO RZ GEOMETRY, 36 REGIONS, 19 MATERIALS, 15 RADIAL MESH POINTS, 20 AXIAL MESH POINTS, 6 RADIAL REGION BOUNDARIES, 10 AXIAL REGION BOUNDARIES, AND INNER AND OUTER AXIAL COOLANTS. KINETICS EQUATIONS ALLOW 6 DELAYED GROUPS AND TWO TEMPERATURE COEFFICIENTS.
6. TYPICAL RUNNING TIME - BEING A KINETICS CODE THE TYPICAL RUNNING TIME IS DEPENDENT UPON THE TIME THAT THE REACTOR IS FOLLOWED.
7. UNUSUAL FEATURES OF THE PROGRAM - THE MATERIAL, GAS, AND COOLANT PROPERTIES AND HEAT GENERATION RATES ARE SUPPLIED AS FORTRAN ARITHMETIC STATEMENT FUNCTIONS. THIS SUBROUTINE IS THEREFORE UNIQUE TO A PARTICULAR FUEL ELEMENT DESIGN AND MAY BE CONSIDERED AS PART OF THE INPUT DATA. FOR CASES IN WHICH THE INITIAL TEMPERATURE DISTRIBUTION IS UNKNOWN IT IS POSSIBLE TO RUN THE BLOOST CODE AS A PURE HEAT-TRANSFER CODE OMITTING REACTIVITY INPUT TO THE KINETICS PORTION AND OBTAIN A TEMPERATURE DISTRIBUTION APPROPRIATE TO INITIAL POWER CONDITIONS PUNCHED ON CARDS SUITABLE FOR LATER USE IN KINETICS PROBLEMS.
8. RELATED AND AUXILIARY PROGRAMS - BLOOST3 - AN EARLIER STAND-ALONE VERSION OF THE KINETICS PORTION.
RAT - AN EARLIER STAND-ALONE HEAT TRANSFER CODE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7044 VERSION SUBMITTED OCTOBER 1965.
10. REFERENCE - M. MERRILL, M. TROOST, BLOOST-5 A COMBINED REACTOR KINETICS-HEAT TRANSFER CODE FOR THE IBM7044, GAMO-6644, AUGUST 17, 1965, AND ADDENDUM, NOVEMBER 9, 1965.
11. MACHINE REQUIREMENTS -

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12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
M. MERRILL
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (7785 CARDS)
REFERENCE REPORT AND ADDENDUM
17. CATEGORY - H
KEYWORDS - HEAT TRANSFER, SPACE-INDEPENDENT KINETICS, 2-DIMENSION-
AL, TEMPERATURE DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - UNPACK
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - UNPACK RETRIEVES NEUTRON CROSS SECTION DATA AND RELATED INFORMATION FROM A SCISRS (BROOKHAVEN NATIONAL LABORATORY) DATA TAPE. THE FORMAT AND STRUCTURE OF THE SCISRS TAPE IS DESCRIBED IN BNL-883 BY FRIEDMAN AND PLATT, JULY 1964.
4. METHOD OF SOLUTION - THE DATA TAPE IS SEARCHED, THE APPROPRIATE RECORDS ARE UNPACKED, AND THE INFORMATION REQUESTED IS PRINTED AND/OR PUNCHED. THE NEUTRON CROSS SECTIONS ARE OBTAINED BY SPECIFICATION OF THE Z AND A NUMBER OF THE PARTICULAR NUCLIDE. A SPECIFIC CROSS SECTION TYPE MAY BE OBTAINED BY INDICATING THE SCISRS REACTION TYPE DESIRED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - DEPENDS ON THE LOCATION OF THE NUCLIDE AND THE NUMBER OF DATA POINTS ON TAPE.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - DATA TAPE IS GENERATED BY SCISRS AT BROOKHAVEN NATIONAL LABORATORY. CARD OUTPUT IS IN FORMAT SUITABLE FOR PROCESSING BY CROSSPLOT (ACC ABSTRACT 207).
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7044 VERSION SUBMITTED NOVEMBER 1965.
10. REFERENCE - C. V. SMITH AND M. K. DRAKE, UNPACK, A NEUTRON CROSS SECTION DATA RETRIEVAL PROGRAM, GA-6685, SEPTEMBER 1, 1965.
11. MACHINE REQUIREMENTS - IBM7044 AND ONE SPECIAL TAPE UNIT, ONE SYSTEM TAPE, ONE INPUT TAPE, AND ONE OUTPUT TAPE
12. PROGRAMMING LANGUAGES USED - FORTRAN IV (75 PER CENT)
MAP (25 PER CENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
GA VERSION OF THE IBM7044 SYSTEM MONITOR, VERSION 9.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
C. V. SMITH
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

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16. MATERIAL AVAILABLE -
SOURCE DECK (626 CARDS)
BINARY DECK (201 CARDS)
SAMPLE PROBLEMS (8 CARDS)
REFERENCE REPORT
17. CATEGORY - M
KEYWORDS - CROSS SECTIONS, LIBRARIES, RETRIEVAL, SCISRS DATA
PROCESSING

1. NAME OR DESIGNATION OF PROGRAM - CROSSPLOT/CROSSPLDT DATA TAPE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044, IBM1401, OR 1460
3. NATURE OF PHYSICAL PROBLEM SOLVED - AUTOMATIC PLOTS ARE GENERATED FROM NEUTRON CROSS SECTION DATA.
4. METHOD OF SOLUTION - POINTWISE EXPERIMENTAL OR EVALUATED CROSS SECTION DATA STORED ON MAGNETIC TAPE ARE SELECTED FOR A PARTICULAR NUCLIDE AND DESIRED ENERGY RANGES AND TRANSFERRED TO A TAPE TOGETHER WITH PLOTTING INSTRUCTIONS IN THE FORM REQUIRED BY THE STROMBERG-CARLSON SC4020 HIGH-SPEED MICROFILM RECORDER. THE 1401 OR 1460 PROGRAM IS INCLUDED WHICH WRITES THE CROSSPLOT DATA TAPE OR MODIFIES OR PRINTS AN EXISTING TAPE. CARDS PUNCHED BY THE UNPACK CODE (ACC ABSTRACT 206) CAN BE WRITTEN AS A CROSSPLOT DATA TAPE BY THIS 1401 OR 1460 CROSSPLOT DATA TAPE PROGRAM.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - FOR EASE IN PLOTTING THE NEUTRON ENERGY RANGE FROM .001 EV TO 20 MEV IS DIVIDED INTO 22 INTERVALS. ANY OR ALL INTERVALS MAY BE PLOTTED AT ONE TIME, AND UP TO 6 SETS OF DATA MAY BE DISPLAYED ON ONE GRAPH USING DIFFERENT PLOTTING CHARACTERS.
6. TYPICAL RUNNING TIME - 580 POINTS CAN BE PROCESSED IN 8 SECONDS.
7. UNUSUAL FEATURES OF THE PROGRAM - OPTIONS ON TYPE AND INTENSITY OF PLOTTING ARE SPECIFIED BY THE USER.
8. RELATED AND AUXILIARY PROGRAMS - CROSSPLOT IS A SPECIAL APPLICATION OF THE GENERAL PURPOSE TPLOT PROGRAM DESCRIBED IN GAMD-4346 (REVISED). SEVERAL SUBROUTINES USED BY CROSSPLOT ARE FROM THE GA PLOT PACKAGE DESCRIBED BY M. L. SKINNER IN GAMD-4974, JANUARY 31, 1964.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7044,40 VERSION SUBMITTED NOVEMBER 1965.
10. REFERENCE - C. V. SMITH, CROSSPLOT, A PROGRAM FOR AUTOMATIC PLOTTING OF DIFFERENTIAL NEUTRON CROSS SECTION DATA, GAMD-6507, JUNE 28, 1965.
11. MACHINE REQUIREMENTS - IBM7044 COMPUTER AND TWO SPECIAL TAPE UNITS AND SYSTEM, INPUT AND OUTPUT TAPES. IBM 1401 WITH 4000 CORE-STORAGE POSITIONS.
12. PROGRAMMING LANGUAGES USED - FORTRAN IV (7044)
SPS (1401)

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13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
GA VERSION OF THE IBM7044 SYSTEM MONITOR, VERSION 9.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
THE IBM1401 OR 1460 IS USED TO PREPARE AND MODIFY THE CROSS PLOT
DATA TAPE.
15. NAME AND ESTABLISHMENT OF AUTHOR -
C. V. SMITH
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (2042 CARDS)
SOURCE DECK
BINARY DECK
SAMPLE PROBLEM
REFERENCE REPORT
17. CATEGORY - N
KEYWORDS - GRAPHS, CROSS SECTIONS, DATA PROCESSING, TPLOT CODES

1. NAME OR DESIGNATION OF PROGRAM - TRIx1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - TRIx1 CALCULATES MULTI-GROUP, DOPPLER-BROADENED EFFECTIVE RESONANCE INTEGRALS AND CROSS SECTIONS AND THEIR TEMPERATURE COEFFICIENTS FOR A HETEROGENEOUS RESONANCE ABSORBER. USING BASIC RESONANCE PARAMETERS, GEOMETRY AND CONCENTRATIONS, THE CODE COMBINES RESOLVED RESONANCE, UNRESOLVED RESONANCE, AND $1/V$ AND NEGATIVE ENERGY RESONANCE CALCULATIONS. FISSILE ISOTOPE CALCULATION IS AVAILABLE. $L=1$ UNRESOLVED RESONANCE CALCULATIONS ARE AVAILABLE FOR ISOTOPES OF ALL SPINS. EQUIVALENCE RELATIONSHIPS ARE CODED FOR CYLINDERS, SPHERES, AND PLANES. INTERFERENCE BETWEEN RESONANCE AND POTENTIAL SCATTERING AND ITS TEMPERATURE DEPENDENCE ARE AVAILABLE. THE NARROW-RESONANCE, INFINITE-MASS, AND INTERMEDIATE REPRESENTATIONS OF SCATTERINGS WITH ABSORBER ATOMS ARE ALL AVAILABLE. THE ISOLATED SINGLE-LEVEL BREIT-WIGNER LINE SHAPE IS USED.
4. METHOD OF SOLUTION - ZERO-DEGREE RESONANCE INTEGRALS ARE EVALUATED USING ANALYTIC FORMULAS DERIVED BY CHERNICK AND VERNON AND GOLDSTEIN AND COHEN. UNRESOLVED RESONANCE INTEGRALS ARE AVERAGED OVER SAMPLES FROM THE STATISTICAL DISTRIBUTIONS OF LEVEL WIDTHS. TEMPERATURE BROADENING IS FOUND BY INTERPOLATING IN TABULATED FUNCTIONS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - RESONANCE PARAMETER LIBRARIES FOR MAXIMA OF 90 ISOTOPES AND 1000 RESONANCES. EACH CASE ACCOMMODATES ONE ISOTOPE AT ONE CONCENTRATION WITH MAXIMA OF 9 TEMPERATURES, 45 ENERGY GROUPS, AND 300 RESOLVED RESONANCES.
6. TYPICAL RUNNING TIME - A FISSILE ISOTOPE WITH 10 ENERGY GROUPS, 3 TEMPERATURES, AND 40 RESONANCES RUNS IN ABOUT ONE MINUTE.
7. UNUSUAL FEATURES OF THE PROGRAM -
 - (1) AN IMPROVED EQUIVALENCE BETWEEN HETEROGENEOUS AND HOMOGENEOUS SYSTEMS CALCULATED FOR EACH RESONANCE.
 - (2) CALCULATION OF INTEGRATED FLUX DEPLETED BY RESONANCE CAPTURE.
 - (3) OPTION TO PUNCH CARDS FOR USE IN PERT, A PERTURBATION THEORY CODE.
 - (4) EXTENSIVE EDIT OF COMPONENTS OF RESONANCE INTEGRALS MAKES CODE CONVENIENT FOR BOTH COMPARISON OF THEORY AND EXPERIMENT AND REACTOR DESIGN.
 - (5) PROVISION TO ADJUST GROUP CROSS SECTIONS TO INFINITELY-DILUTE STANDARDS.
 - (6) ADDRESSABLE INPUT DATA IS USED SO THAT MULTIPLE CASES NEED SPECIFY ONLY CHANGES.

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8. RELATED AND AUXILIARY PROGRAMS - PUNDIT, PUNCHES BINARY CARDS FOR (J TABLE) DOPPLER-BROADENING TABLE FOR SYMMETRIC LINE SHAPE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7094 VERSION SUBMITTED NOVEMBER 1965.
10. REFERENCE - J. M. OTTER, THE TRIX-1 CODE, AN IMPROVED ANALYTIC CALCULATION OF RESONANCE INTEGRALS, NAA-SR-MEMO-11538, SEPTEMBER 1965.
11. MACHINE REQUIREMENTS - 32K IBM7094
12. PROGRAMMING LANGUAGES USED - FORTRAN IV (90 PERCENT)
MAP (10 PERCENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBSYS.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - SEE PAGE 22 OF THE REFERENCE REPORT FOR THE DECK SETUP. ITEM 3 (THE DOPPLER-BROADENING TABLE FOR SYMMETRIC LINE SHAPE) IS PREPARED BY RUNNING THE PUNDIT PROGRAM TO PRODUCE A DECK OF BINARY DATA CARDS. REMOVE COMMENT CARDS IN FRONT OF ITEMS 2, 3, 4, AND 5 BEFORE RUNNING PROGRAM.
15. NAME AND ESTABLISHMENT OF AUTHOR -
J. M. OTTER
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA 91304
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (3060 CARDS)
SOURCE DECK (1847 CARDS)
SAMPLE PROBLEM (30 CARDS)
PUNDIT SOURCE DECK AND DATA (431 CARDS)
DOPPLER-BROADENING TABLE FOR SCATTERING INTERFERENCE (61 CARDS)
RESONANCE PARAMETERS LIBRARIES (683 CARDS)
REFERENCE REPORT
17. CATEGORY - A
KEYWORDS - RESONANCE INTEGRALS, DOPPLER BROADENING, MULTIGROUP CROSS SECTIONS, RESOLVED REGION, UNRESOLVED REGION, BREIT-WIGNER FORMULA, PUNDIT CODES

1. NAME OR DESIGNATION OF PROGRAM - DTF4
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7030, 94, 360, CDC6600, GE625
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE LINEAR, TIME-INDEPENDENT, BOLTZMANN EQUATION FOR PARTICLE TRANSPORT IS SOLVED FOR THE ENERGY, SPACE, AND ANGULAR DEPENDENCE OF THE PARTICLE DISTRIBUTION IN ONE-DIMENSIONAL SLABS, CYLINDERS, AND SPHERES. INDEPENDENT SOURCE OR EIGENVALUE (MULTIPLICATION, TIME-ABSORPTION, ELEMENT CONCENTRATION, ZONE THICKNESS OR SYSTEM DIMENSION) PROBLEMS ARE SOLVED SUBJECT TO VACUUM, REFLECTIVE, OR PERIODIC BOUNDARY CONDITIONS. A COMPLETE ENERGY-TRANSFER SCATTERING MATRIX IS ALLOWED FOR EACH LEGENDRE COMPONENT OF THE SCATTERING CROSS SECTION MATRICES.
4. METHOD OF SOLUTION - ENERGY DEPENDENCE IS TREATED BY THE MULTI-GROUP APPROXIMATION AND ANGULAR DEPENDENCE BY A GENERAL DISCRETE ORDINATES APPROXIMATION. ANISOTROPIC SCATTERING IS APPROXIMATED BY A TRUNCATED SPHERICAL HARMONICS EXPANSION OF THE SCATTERING KERNEL. WITHIN-GROUP SCATTERING AND UP-SCATTERING (IF ANY) ITERATION PROCESSES ARE ACCELERATED BY SYSTEM-WIDE RENORMALIZATION PROCEDURES. APPROXIMATIONS AND ITERATIVE CYCLES ARE DESCRIBED IN DETAIL IN THE DTF4 REPORT.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE VARIABLE DIMENSIONING CAPABILITY OF FORTRAN IV HAS BEEN UTILIZED SO THAT ANY COMBINATION OF NUMBER OF GROUPS, NUMBER OF SPATIAL INTERVALS, SIZE OF ANGULAR QUADRATURE, ETC., CAN BE USED THAT WILL FIT WITHIN THE TOTAL CORE STORAGE AVAILABLE TO A USER. THE CODE ITSELF REQUIRES ABOUT 8000 WORDS, BUT IT CAN BE SHORTENED BY DELETING CERTAIN SUBROUTINES WHICH PERFORM OPTIONAL CALCULATIONS.
6. TYPICAL RUNNING TIME - IBM7030
 - (A) ONE-GROUP, S16, 40 SPATIAL INTERVALS, SPHERICAL CRITICAL RADIUS SEARCH - 0.833 MINUTES.
 - (B) SIX-GROUP, S48, 160 SPATIAL INTERVALS, SPHERICAL CRITICALITY SEARCH - 29.73 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - GENERAL ANISOTROPIC SCATTERING CAPABILITY IS PROVIDED IN EACH OF THE THREE GEOMETRIES, UP-SCATTERING CONVERGENCE ACCELERATION IS USED, AN OPTIONAL GROUP-AND POINT-WISE CONVERGENCE TEST IS AVAILABLE, AND A NEUTRON CONSERVING NEGATIVE FLUX CORRECTION ROUTINE IS USED.
8. RELATED AND AUXILIARY PROGRAMS - THE CODE IS A MAJOR REVISION OF THE DTF (ACC ABSTRACT 144) CODE. IN ADDITION TO THE DIFFERENCES NOTED IN ITEMS 5 AND 7 ABOVE, DTF4 DIFFERS FROM DTF IN TWELVE OTHER WAYS WHICH ARE LISTED IN THE DTF4 REPORT. THE REPORT GAMLEG (REFERENCE 3) PROVIDES CROSS SECTIONS FOR PHOTON TRANSPORT PROBLEMS IN A FORM SUITABLE FOR INPUT TO DTF4.

9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
 IBM7030 VERSION SUBMITTED DECEMBER 1965.
 IBM7090 VERSION SUBMITTED JULY 1966.
 GE625 VERSION SUBMITTED OCTOBER 1966.
 CDC6600 VERSION SUBMITTED NOVEMBER 1966.
 IBM360 VERSION SUBMITTED APRIL 1967.
10. REFERENCES - K. D. LATHROP, DTF-IV, A FORTRAN-IV PROGRAM FOR SOLVING THE MULTIGROUP TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING, LA-3373, JULY 15, 1965.
 B. G. CARLSON, W. J. WORLTON, W. GUBER, AND M. SHAPIRO, DTF USERS MANUAL, UNC PHYS/MATH 3321, VOLUMES I AND II, 1963.
 K. D. LATHROP, GAMLEG, CCA-115, NUCLEAR SCIENCE AND ENGINEERING, VOL. 24, FEBRUARY 1966.
 G. J. DUFFY, PROGRAMMING NOTES 360/MODEL 50 TWO-WORD FLOATING-POINT VERSION OF DTF-IV, FEBRUARY 1967.
11. MACHINE REQUIREMENTS - NO DISCS OR TAPES ARE USED. A CLOCK IS USED BUT, BY REMOVING A FEW PROGRAM STATEMENTS, THIS REQUIREMENT CAN BE ELIMINATED.
12. PROGRAMMING LANGUAGE USED - FORTRAN IV IS USED, PRIMARILY TO UTILIZE VARIABLE DIMENSIONING AND LOGICAL BRANCHING CAPABILITIES.
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD FORTRAN MONITOR (7090), OS/360 (360), AND SCOPE (6600).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -

7030 AND 6600	K. D. LATHROP LOS ALAMOS SCIENTIFIC LABORATORY P. O. BOX 1663 LOS ALAMOS, NEW MEXICO
7094	G. P. LAHTI NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LEWIS RESEARCH CENTER 21000 BROOKPARK ROAD CLEVELAND, OHIO 44135
625	R. L. BRUNNENMEYER BECHTEL CORPORATION 220 BUSH STREET SAN FRANCISCO, CALIFORNIA 94119
360	G. J. DUFFY APPLIED MATHEMATICS DIVISION ARGONNE NATIONAL LABORATORY 9700 SOUTH CASS AVENUE ARGONNE, ILLINOIS 60439

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7030-2083 CARDS, 6600-2072 CARDS, 7094-1799
CARDS, 625-2198 CARDS, AND 360-1860 CARDS)
SAMPLE PROBLEMS (7030-322 CARDS, 6600-322 CARDS, 7094-27 CARDS,
625-25 CARDS, AND 360-76 CARDS)
REFERENCE REPORT, LA-3373, AND NOTES
17. CATEGORY - C
KEYWORDS - TRANSPORT THEORY, 1-DIMENSIONAL, MULTIGROUP, SLABS,
CYLINDERS, SPHERES, CRITICALITY SEARCHES, ANISOTROPIC
SCATTERING

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1. NAME OR DESIGNATION OF PROGRAM - DTX
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, CDC1604
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE DTX CODE CALCULATES EFFECTIVE MACROSCOPIC, HOMOGENEOUS, GROUP CROSS SECTIONS WHICH ARE SPACE-AVERAGED OVER THE FLUXES AND CURRENTS PRE-CALCULATED IN A ONE-DIMENSIONAL NEUTRON TRANSPORT CODE SUCH AS DTK OR DSN. ISOTROPIC AND ANISOTROPIC CROSS SECTIONS MAY BE INCLUDED.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - MACHINE TIME FOR THE CDC1604 VERSION IS TWO MINUTES FOR A 16 GROUP, 30 INTERVAL, 4 MATERIAL, ANISOTROPIC CALCULATION.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - DTX IS ESSENTIALLY A SERVICE PROGRAM USED WITH A ONE-DIMENSIONAL SN CODE SUCH AS DTK AND/OR DSN WHICH SOLVE THE PRIMARY EIGENVALUE PROBLEM.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
PROGRAM SUBMITTED JULY 1965.
10. REFERENCES - BENGT G. CARLSON, CHESTER S. KAZEK, JR., AND CLARENCE E. LEE, FLOCO II MANUAL, LAMS-2339, OCTOBER 1959.
R. E. LAWRENCE, LAG - A LOAD AND GO ASSEMBLER WRITTEN FOR THE CDC1604B COMPUTER, TIM-939, JULY 1965.
R. J. RODGERS, DTX, CALCULATIONS OF EFFECTIVE MACROSCOPIC CROSS-SECTIONS, TIM-947, JULY 1965.
11. MACHINE REQUIREMENTS - IBM FLOCO COMPILER OR CDC1604 SUBASSEMBLER, LAG1
12. PROGRAMMING LANGUAGES USED - LAG1 (1604) AND FLOCO (7090)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM OR CDC MONITOR SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
RICHARD J. RODGERS
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT

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16. MATERIAL AVAILABLE -
SOURCE DECK WITH SAMPLE PROBLEM (1604-200 CARDS)
REFERENCE REPORTS, TIM-939 AND TIM-947
17. CATEGORY - N
KEYWORDS - AVERAGES CROSS SECTIONS, DTK CODES, DSN CODES, OUTPUT
DATA, DATA PROCESSING

1. NAME OR DESIGNATION OF PROGRAM - MGDSN, MANY GROUP DSN
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC1604B
3. NATURE OF PHYSICAL PROBLEM SOLVED - MGDSN IS A MODIFICATION OF DSN, THE ONE-DIMENSIONAL THEORY CODE DESIGNED TO ACCOMMODATE 100 GROUP ISOTROPIC MATERIAL CROSS SECTION DATA TAPES PREPARED BY CSP1 AND CSP2A.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE PRESENT VERSION OF MGDSN WILL SOLVE THE K OR EIGENVALUE PROBLEM WITH THE ISOTROPIC OPTION. SLIGHT CHANGES MAY BE NEEDED TO INCLUDE OTHER OPTIONS.
6. TYPICAL RUNNING TIME - RUNNING TIMES ARE DEPENDENT ON THE NUMBER OF SPACE POINTS, SN ORDER, PRECISION DESIRED, NUMBER OF GROUPS AND NUMBER OF GROUPS PER SEGMENT. FOR A 100 GROUP PROBLEM WITH 10 GROUPS PER SEGMENT, S4, 19 SPACE INTERVALS AND $E=10^{+4}$, THE RUNNING TIME WAS 60 MINUTES FOR APPROXIMATELY 8100 INNER ITERATIONS.
7. UNUSUAL FEATURES OF THE PROGRAM - MGDSN GIVES THE FLEXIBILITY OF PERFORMING A MANY GROUP PROBLEM WITHOUT REQUIRING AN EXORBITANT AMOUNT OF STORAGE FOR CROSS SECTION DATA.
8. RELATED AND AUXILIARY PROGRAMS - DSN, ONE DIMENSIONAL SN THEORY CODE, CSP1 (ACC ABSTRACT 194), CSP2A (ACC ABSTRACT 193), LAG1 (ACC ABSTRACT 186).
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC1604 VERSION SUBMITTED JULY 1965.
10. REFERENCES - R. J. RODGERS, MGDSN-MANY GROUP DSN, TIM-938, JULY 16, 1965.
BENGT G. CARLSON, C. LEE, J. WORLTON, THE DSN AND TDC NEUTRON TRANSPORT CODES, LAMS-2346, OCTOBER 1959.
J. A. LOFFREDA, R. J. CACCIAPOUTI, CSP1-A CODE FOR PREPARING 100 GROUP CROSS SECTIONS FOR SN CODE, TIM-930, JULY 12, 1965.
J. A. LOFFREDA, R. J. CACCIAPOUTI, CSP2A-A CODE FOR PREPARING 100 GROUP FORWARD AND ADJOINT MACROSCOPIC CROSS SECTIONS FOR SN CODES, TIM-931, JULY 12, 1965.
R. E. LAWRENCE, LAG-A LOAD AND GO ASSEMBLER WRITTEN FOR THE CDC1604B COMPUTER, TIM-939, JULY 22, 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY AND TAPE UNIT NUMBER 2 ASSIGNED FOR CROSS SECTION DATA TAPE

12. PROGRAMMING LANGUAGE USED - LAG1, SLIGHT CHANGES NEEDED TO RECONVERT TO FLOCO 11.
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - COOP.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
R. J. RODGERS (MGOSN)
PRATT AND WHITNEY AIRCRAFT-CANEL
MIDDLETOWN, CONNECTICUT

BENGT G. CARLSON (OSN)
LOS ALAMOS SCIENTIFIC LABORATORY
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO
16. MATERIAL AVAILABLE -
SOURCE DECK WITH SAMPLE PROBLEM (389 CARDS)
REFERENCE REPORTS, TIM-938, TIM-930, TIM-931, TIM-939
17. CATEGORY - C
KEYWORDS - SN METHOD, 1-DIMENSIONAL, MULTIGROUP, SLABS, CYLINDERS,
SPHERES, REACTIVITY, FLUX DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - VARI-QUIR
2. COMPUTER FOR WHICH THE PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE TIME-DEPENDENT, MULTI-GROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y OR R-Z GEOMETRY.
4. METHOD OF SOLUTION - MODIFIED-EULER WITH A SINGLE ITERATION. THE ICE SUBROUTINE IS USED. (AAICE3 - INTEGRATION WITH CONTROLLED ERROR).
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
 - 4 GROUPS
 - 6 PRECURSOR GROUPS
 - 36 REGIONS
 - 20 DIFFERENT MATERIALS
6. TYPICAL RUNNING TIME - THE RUNNING TIME IS A FUNCTION OF THE TYPE OF PROBLEM, THE PRECISION ONE WANTS AND THE REAL PROBLEM TIME.
7. UNUSUAL FEATURES OF THE PROGRAM - FEEDBACK IS INTRODUCED INTO THE CODE THROUGH THREE SUBROUTINES...TO INITIALIZE THE FEEDBACK, TO CARRY IT THROUGH, AND TO PRINT OUT ANY DESIRED FEEDBACK VARIABLES AT VARIOUS TIMES. THESE SUBROUTINES ARE WRITTEN BY THE USER, SO THAT ANY DESIRED FEEDBACK MAY BE INTRODUCED.
8. RELATED AND AUXILIARY PROGRAMS - VARI-QUIR REQUIRES THE ICE SUBROUTINE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
IBM7090 VERSION SUBMITTED DECEMBER 1965.
10. REFERENCE - J. W. RIESE, G. COLLIER, AND C. E. RIECK, VARI-QUIR, A TWO-DIMENSIONAL TIME-DEPENDENT MULTI-GROUP DIFFUSION CODE, WANL-TNR-133 REVISED, DECEMBER 1965.
11. MACHINE REQUIREMENTS - IBM7090 WITH 32K CORE AND ON-LINE PRINTER, INPUT, OUTPUT, AND CHAIN TAPES
12. PROGRAMMING LANGUAGES USED - VARI-QUIR WAS PROGRAMMED COMPLETELY IN FORTRAN II, BUT THE ICE SUBROUTINE IS IN FAP.
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

GEORGE COLLIER
REACTOR PHYSICS AND MATHEMATICS
WESTINGHOUSE ELECTRIC CORPORATION
ASTRONUCLEAR LABORATORY
P. O. BOX 10864
PITTSBURGH, PENNSYLVANIA 15236

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECK (1995 CARDS)
SAMPLE PROBLEM (78 CARDS)
REFERENCE REPORT

17. CATEGORY - C

KEYWORDS - SPACE-TIME, 2-DIMENSIONAL, DIFFUSION EQUATIONS, X-Y,
R-2, FLUX DISTRIBUTION, FEEDBACK, ICE CODES

1. NAME OR DESIGNATION OF PROGRAM - RIFF RAFF
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PROGRAM COMPUTES RESONANCE INTEGRALS FOR ABSORBERS IN A ROD IN A TWO-REGION CIRCULARIZED CELL FOR ABOVE THERMAL ENERGIES. THE FLUX DISTRIBUTION IN THE CELL IS ALSO COMPUTED AND CAN BE PRINTED. THE METHOD OF SOLUTION IS BASED UPON THE FOLLOWING ASSUMPTIONS - ISOTROPIC SCATTERING IN THE LABORATORY SYSTEM, CONSTANT TOTAL CROSS SECTION IN THE MODERATOR AND ISOTROPIC NEUTRON FLUXES ENTERING AND LEAVING THE ROD.
4. METHOD OF SOLUTION - AN ENERGY RANGE OF INTEREST IS DIVIDED INTO EXTREMELY NARROW INTERVALS OF EQUAL LETHARGY. FOR EACH INTERVAL THE SOURCE DISTRIBUTION IN EACH REGION IS TAKEN TO BE A THREE TERM POLYNOMIAL IN THE RADIAL COORDINATE. WITH THIS FORM FOR THE SOURCE, REACTION RATES IN THE ROD ARE OBTAINED BY USE OF FIRST FLIGHT ESCAPE PROBABILITIES. THE FLUX DISTRIBUTION IN THE ROD IS OBTAINED FROM USE OF CODYS MOMENT METHOD AND THE FLUX DISTRIBUTION IN THE MODERATOR IS OBTAINED BY REQUIRING - NEUTRON CONSERVATION, VANISHING OF THE DERIVATIVE OF THE FLUX AT THE CELL BOUNDARY AND EQUALITY OF THE FLUXES AT THE FUEL-MODERATOR INTERFACE. THE REACTION RATES ARE ACCUMULATED OVER SPECIFIED ENERGY INTERVALS TO OBTAIN RESONANCE INTEGRALS. THE FLUX DISTRIBUTION IS USED TO OBTAIN THE SOURCE DISTRIBUTION FOR INTERVALS AT LOWER ENERGIES. RESONANCES ARE DESCRIBED BY THE SINGLE-LEVEL BREIT-WIGNER FORMULATION WITH INTERFERENCE SCATTERING INCLUDED. ALL RESONANCES CONTRIBUTE TO CROSS SECTIONS FOR EACH FINE GROUP.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE PROGRAM ALLOWS FOR 10 MATERIALS IN EACH REGION. THERE CAN BE 4 RESONANT ABSORBERS IN THE ROD, EACH HAVING 60 RESONANCES. THE NON-RESONANT MATERIALS CAN HAVE $1/v$ ABSORPTION CROSS SECTIONS WITH THE RESTRICTION THAT FOR THE MODERATOR, THE MACROSCOPIC ABSORPTION CROSS SECTION MUST BE SMALL COMPARED TO THE SCATTERING CROSS SECTION. THE WIDTH OF THE MODERATOR IN MEAN FREE PATHS SHOULD EXCEED 0.2. FLUXES FOR 600 GROUPS ARE STORED.
6. TYPICAL RUNNING TIME - RUNNING TIME IS ROUGHLY PROPORTIONAL TO THE PRODUCT OF RESONANCES AND FINE GROUPS. THE RUNNING TIME FOR A PROBLEM WITH 20 RESONANCES AND 5000 FINE GROUPS IS ABOUT 2 MINUTES FOR THE CDC3600.
7. UNUSUAL FEATURES OF THE PROGRAM - STANDARD METHODS OF TREATING RESONANCE ABSORPTION ARE BASED ON THE NARROW RESONANCE APPROXIMATION IN THE MODERATOR AND THE FLAT FLUX APPROXIMATION IN THE FUEL ROD. BECAUSE THE PROGRAM USES SPACE AND LETHARGY DEPENDENT SOURCES IN COMPUTING RESONANCE INTEGRALS, THESE STANDARD APPROXIMATIONS BETWEEN RESONANCES SIGNIFICANTLY AFFECTS RESONANCE INTEGRALS.

8. RELATED AND AUXILIARY PROGRAMS - MISH MASH (ACC ABSTRACT 214)
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC3600 VERSION SUBMITTED JANUARY 1966, SAMPLE PROBLEM
EXECUTED BY ACC.
10. REFERENCE - P. H. KIER, RIFF RAFF, A PROGRAM FOR COMPUTATION OF
RESONANCE INTEGRALS IN A TWO-REGION CELL, ANL-7033, AUGUST 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY. INPUT IS BY PUNCHED CARD AND
OUTPUT USES AN OFF-LINE PRINTER.
12. PROGRAMMING LANGUAGE USED - CDC3600 FORTRAN
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
SCOPE.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
DATA STATEMENTS ARE USED TO STORE EXTENSIVE TABLES WITHIN THE
PROGRAM. IF THE PROGRAM IS TO BE USED ON COMPUTERS THAT DO NOT
ALLOW DATA STATEMENTS THESE TABLES MUST BE ENTERED BY USE OF CARDS
OR TAPE. A SUBROUTINE, FLUXP, TOGETHER WITH ITS INPUT, WHICH
COMPUTES AND PUNCHES THE DATA IN THESE TABLES ON CARDS IS IN-
CLUDED IN THE PACKAGE.
15. NAME AND ESTABLISHMENT OF AUTHOR -
P. H. KIER
REACTOR PHYSICS DIVISION
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (RIFF RAFF 1933 CARDS AND FLUXP 68 CARDS)
BINARY DECK (RIFF RAFF 795 CARDS)
SAMPLE PROBLEMS (RIFF RAFF 30 CARDS AND FLUXP 154 CARDS)
REFERENCE REPORT
17. CATEGORY - B
KEYWORDS - RESONANCE INTEGRALS, CELL CALCULATION, FLUX DISTRIBU-
TION, ISOTROPIC SCATTERING, FLUXP CODES

REACTOR CODE ABSTRACT 214

10/67

1. NAME OR DESIGNATION OF PROGRAM - MISH MASH
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PROGRAM COMPUTES RESONANCE INTEGRALS FOR INFINITE HOMOGENEOUS MIXTURES FOR ABOVE THERMAL ENERGIES. THE MAJOR PHYSICAL APPROXIMATION IS THAT RESONANCES ARE REPRESENTED BY THE SINGLE-LEVEL BREIT-WIGNER FORMULATION. IT IS ALSO ASSUMED THAT SCATTERING IS ELASTIC AND THAT A NONRESONANT MATERIAL HAS A CONSTANT SCATTERING CROSS SECTION.
4. METHOD OF SOLUTION - THE ENERGY RANGE OF INTEREST IS DIVIDED INTO MANY EXTREMELY NARROW INTERVALS OF EQUAL LETHARGY WIDTH. FOR SUCH NARROW INTERVALS THE COLLISION DENSITY IS IDENTICAL TO THE SOURCE AND THE FLUX IS THE SOURCE DIVIDED BY THE TOTAL CROSS SECTION. FROM THE FLUX AND THE CROSS SECTION FOR A PROCESS, THE REACTION RATE FOR THE INTERVAL IS COMPUTED. BY ACCUMULATING THE REACTION RATE OVER A SPECIFIED ENERGY RANGE A RESONANCE INTEGRAL IS OBTAINED. ALL RESONANCES PRESENT CONTRIBUTE TO THE CROSS SECTIONS FOR EACH INTERVAL.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE PROGRAM ALLOWS THE MIXTURE TO CONTAIN 12 MATERIALS OF WHICH 4 CAN BE RESONANT ABSORBERS. EACH RESONANT ABSORBER CAN HAVE UP TO 60 RESONANCES. FLUXES AND RESONANT SCATTERING CROSS SECTIONS ARE STORED FOR 2400 ENERGY INTERVALS.
6. TYPICAL RUNNING TIME - RUNNING TIME IS PROPORTIONAL TO THE PRODUCT OF ENERGY INTERVALS AND RESONANCES. A PROBLEM WITH 10,000 ENERGY POINTS AND 25 RESONANCES REQUIRES 2 MINUTES ON THE CDC3600.
7. UNUSUAL FEATURES OF THE PROGRAM - MOST METHODS OF COMPUTING RESONANCE INTEGRALS ARE BASED ON THE ASSUMPTION THAT THE NEUTRON SOURCE IS INDEPENDENT OF ENERGY. IN THIS PROGRAM, THE SOURCE FOR AN ENERGY INTERVAL IS COMPUTED PRECISELY FROM THE FLUX AND SCATTERING CROSS SECTIONS FOR THAT RANGE OF ENERGIES FROM WHICH NEUTRONS CAN BE SCATTERED. BECAUSE OF THE METHOD OF COMPUTING THE SOURCE, THE PROGRAM IS WELL SUITED FOR TREATING PROBLEMS WHERE RESONANCE OVERLAPPING OR NON-RECOVERY OF THE FLUX BETWEEN RESONANCES SHOULD SIGNIFICANTLY AFFECT RESONANCE INTEGRALS.
8. RELATED AND AUXILIARY PROGRAMS - THE PROGRAM IS A MODIFICATION AND CONDENSATION OF RIFF RAFF (ACC ABSTRACT 213) WHICH TREATS RESONANCE ABSORPTION BY A ROD IN A TWO-REGION CIRCULARIZED CELL.
9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
CDC3600 VERSION SUBMITTED JANUARY 1966, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - P. H. KIER, RIFF RAFF, A PROGRAM FOR COMPUTATION OF RESONANCE INTEGRALS IN A TWO-REGION CELL, ANL-7033, AUGUST 1965.
P. H. KIER, MISH MASH, A HOMOGENEOUS RESONANCE INTEGRAL CODE, ANL MEMORANDUM, JANUARY 1966.
11. MACHINE REQUIREMENTS - 32K MEMORY. INPUT IS BY PUNCHED CARD AND OUTPUT IS ON AN OFF-LINE PRINTER.
12. PROGRAMMING LANGUAGE USED - CDC3600 FORTRAN
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - CONVERSION FOR USE ON COMPUTERS OTHER THAN THE CDC3600 SHOULD REQUIRE ONLY SLIGHT MODIFICATION OF THE PROGRAM.
15. NAME AND ESTABLISHMENT OF AUTHOR -
P. H. KIER
REACTOR PHYSICS DIVISION
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439
16. MATERIAL AVAILABLE -
SOURCE DECK (491 CARDS)
BINARY DECK (246 CARDS)
SAMPLE PROBLEM (28 CARDS)
REFERENCE REPORT AND MEMORANDUM
17. CATEGORY - A
KEYWORDS - RESONANCE INTEGRALS, BREIT-WIGNER FORMULA, ELASTIC SCATTERING, REACTION RATES, FLUX DISTRIBUTION

REACTOR CODE ABSTRACT 215

10/67

1. NAME OR DESIGNATION OF PROGRAM - CHAD
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - CHAD IS DESIGNED TO FACILITATE ANALYSIS AND HANDLING OF DIFFERENTIAL NEUTRON SCATTERING DATA. IT PRODUCES LEGENDRE SCATTERING COEFFICIENTS FROM ANGULAR DISTRIBUTION DATA TABULATED IN MANY DIFFERENT FORMATS. IT CAN TRANSFORM ANGULAR DATA INTO LEGENDRE SCATTERING COEFFICIENTS IN EITHER THE LABORATORY OR THE CENTER-OF-MASS FRAME OF REFERENCE. IT CALCULATES THE AVERAGE COSINE OF THE SCATTERING ANGLE IN THE LABORATORY SYSTEM AND THE AVERAGE LOGARITHMIC ENERGY DECREMENT PER ELASTIC COLLISION.
4. METHOD OF SOLUTION - A RECURSIVE METHOD IS USED FOR CALCULATING THE TRANSFORMATION MATRICES WHICH CONVERT LEGENDRE COEFFICIENTS FROM ONE FRAME OF REFERENCE (LABORATORY OR CENTER-OF-MASS) TO THE OTHER. THE LEGENDRE SCATTERING COEFFICIENTS, THE AVERAGE COSINE OF THE SCATTERING ANGLE IN THE LABORATORY SYSTEM, AND THE AVERAGE LOGARITHMIC ENERGY DECREMENT PER ELASTIC COLLISION ARE OBTAINED ANALYTICALLY FROM DIFFERENTIAL SCATTERING DATA SPECIFIED FOR A DISCRETE SET OF VALUES OF THE SCATTERING ANGLE COSINE AT A SPECIFIED NEUTRON ENERGY, ASSUMING THAT THE DIFFERENTIAL CROSS SECTION IS A LINEAR FUNCTION BETWEEN POINTS. THESE INPUT DATA MAY BE IN EITHER THE LABORATORY OR CENTER-OF-MASS SYSTEM.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
ATOMIC MASS GREATER THAN 1.
MAXIMUM NUMBER OF LEGENDRE COEFFICIENTS = 30
MAXIMUM NUMBER OF VALUES OF THE COSINE OF THE SCATTERING ANGLE = 100
6. TYPICAL RUNNING TIME - ONE MINUTE FOR A CASE WITH 10 COEFFICIENTS DESIRED AT 36 ENERGY POINTS, INCLUDING PRINTED, PUNCHED, AND GRAPHICAL OUTPUT.
7. UNUSUAL FEATURES OF THE PROGRAM -
(A) CHAD PUNCHES OUTPUT WHICH IS COMPATIBLE WITH THE ATOMICS INTERNATIONAL EVALUATED NUCLEAR DATA FILE (AIECDF).
(B) THE PROGRAM CAN USE AN SC-4020 GRAPHICAL DISPLAY DEVICE FOR PLOTTING RESULTS.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7094 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCES - R. F. BERLAND, CHAD - CODE TO HANDLE ANGULAR DATA, NAA-SR-11231, DECEMBER 31, 1965.
M. HOFFMAN AND W. A. RHODES, AICRT3, A GENERAL CODE FOR DISPLAY OF DIGITAL DATA, NAA-SR-MEMO-9069, OCTOBER 1963.

11. MACHINE REQUIREMENTS - 32K IBM7094
12. PROGRAMMING LANGUAGES USED - FORTRAN IV (85 PERCENT)
MAP (15 PERCENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBSYS.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
IF AN SC-4020 GRAPHICAL DISPLAY DEVICE IS AVAILABLE, THE SUB-
ROUTINE DUMMY SHOULD BE REPLACED WITH THE SUBROUTINE AICRT3.
THE FORTRAN IV AICRT3 SUBROUTINE AND THE NAA-SC-4020 SUBROUTINE
PACKAGE ARE AVAILABLE THROUGH -
UAIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. F. BERLAND
MATHEMATICAL AND COMPUTING SCIENCES GROUP
ATOMICS INTERNATIONAL
P. O. BOX 309
CANDGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE -
SOURCE DECK (1221 CARDS)
SAMPLE PROBLEM (39 CARDS)
REFERENCE REPORTS
17. CATEGORY - A
KEYWORDS - ELASTIC SCATTERING, CROSS SECTIONS, LEGENDRE COEFFI-
CIENTS, ANGULAR DISTRIBUTION, GRAPHS

REACTOR CODE ABSTRACT 216

10/67

1. NAME OR DESIGNATION OF PROGRAM - FASDOP
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - FASDOP EVALUATES POINTWISE, TEMPERATURE-DEPENDENT CROSS SECTIONS FROM SINGLE-LEVEL BREIT-WIGNER RESONANCE PARAMETERS.
4. METHOD OF SOLUTION - A MODIFIED VERSION OF THE METHOD OF TRIPLETT, MERRILL, AND BURR.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
NUMBER OF RESONANCES EQUAL TO OR LESS THAN 500.
NUMBER OF ENERGY POINTS AT WHICH CROSS SECTIONS ARE EVALUATED EQUAL TO OR LESS THAN 500.
6. TYPICAL RUNNING TIME - RUNNING TIME IS 5 MINUTES FOR A PROBLEM USING 114 RESONANCES AND 2400 POINTS.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCES - J. R. TRIPLETT, E. T. MERRILL, AND J. R. BURR, THE RBV REACTOR-BURNUP CODE--FORMULATION AND OPERATING PROCEDURES, HW-70049, JULY 1961.
C. A. STEVENS, FASDOP, A FORTRAN IV COMPUTER PROGRAM FOR COMPUTING CROSS SECTIONS FROM RESONANCE PARAMETERS, GAMD-6562, AUGUST 9, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
C. A. STEVENS
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

REACTOR CODE ABSTRACT 216

-2-

10/67

16. MATERIAL AVAILABLE -
SOURCE DECK (518 CARDS)
SAMPLE PROBLEM (9 CARDS)
REFERENCE REPORT, GAMD-6562
17. CATEGORY - A
KEYWORDS - CROSS SECTIONS, BREIT-WIGNER FORMULA, RESONANCE PARAMETERS, TEMPERATURE DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - LEGCOEF3/GEORGE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - CALCULATES LEGENDRE EXPANSION COEFFICIENTS FOR THE ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS.
4. METHOD OF SOLUTION -
 - (A) COEFFICIENTS ARE OBTAINED BY A LEAST SQUARES FIT TO A FINITE LEGENDRE POLYNOMIAL SERIES.
 - (B) STANDARD METHODS OF OBTAINING COEFFICIENTS FOR THE ORTHOGONAL POLYNOMIAL ARE USED. THE INTEGRATION IS DONE BY THE TRAPEZOIDAL METHOD.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
20 LEGENDRE COEFFICIENTS
500 INPUT ANGLE-CROSS SECTION PAIRS
6. TYPICAL RUNNING TIME - 1.8 SECONDS FOR A PROBLEM WITH 15 COEFFICIENTS AND 100 INPUT DATA POINTS.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - GEORGE, A SUPPLEMENTAL PROGRAM, IS USED TO CALCULATE THE ANGULAR CROSS SECTION AT A GIVEN ENERGY. THIS CODE TAKES, AS INPUT, SETS OF LEGENDRE COEFFICIENTS AND SCATTERING CROSS SECTIONS FOR A PARTICULAR ENERGY MESH. ANGULAR SCATTERING CROSS SECTIONS ARE THEN CALCULATED AT THE SAME OR ANOTHER ENERGY MESH. LEGENDRE COEFFICIENTS REQUIRED FOR ENERGIES, NOT GIVEN AS INPUT, ARE INTERPOLATED FROM THE TABLE OF THOSE GIVEN.
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - C. V. SMITH AND M. K. DRAKE, LEGCOEF-3, A PROGRAM TO CALCULATE LEGENDRE EXPANSION COEFFICIENTS FOR THE ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS, GA-6690, SEPTEMBER 1, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

16. MATERIAL AVAILABLE -

SOURCE DECKS (502 CARDS)
SAMPLE PROBLEM (62 CARDS)
REFERENCE REPORT

17. CATEGORY - A

KEYWORDS - LEGENDRE COEFFICIENTS, ELASTIC SCATTERING, ANGULAR DISTRIBUTION, CROSS SECTIONS, GEORGE CODES

REACTOR CODE ABSTRACT 218

10/67

1. NAME OR DESIGNATION OF PROGRAM - GAVER
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - GAVER CALCULATES GROUP AVERAGED CROSS SECTIONS FROM POINTWISE CROSS SECTION DATA FOR THE GAM2 99 FINE-GROUP LIBRARY. THE INPUT DATA ARE USED TO OBTAIN A SET OF INTERPOLATED CROSS SECTIONS, WHERE 20 INTERPOLATED CROSS SECTIONS ARE OBTAINED FOR EACH FINE GROUP. WHERE INPUT DATA DO NOT COVER THE FULL RANGE OF A FINE GROUP, THE GROUP-AVERAGED CROSS SECTION IS SET TO ZERO.
4. METHOD OF SOLUTION - TRAPEZOIDAL INTEGRATION IS USED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
99 FINE GROUPS
5000 INPUT DATA POINTS FOR CROSS SECTION-ENERGY PAIRS
6. TYPICAL RUNNING TIME - 18 SECONDS IS REQUIRED FOR A 99 GROUP, 1000 INPUT DATA POINT PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM - THREE METHODS OF CROSS SECTION INTERPOLATION ARE AVAILABLE -
 - (1) LINEAR, IN ENERGY, BETWEEN INPUT ENERGY POINTS.
 - (2) LINEAR, ON A LETHARGY SCALE, BETWEEN INPUT ENERGY POINTS.
 - (3) EXPONENTIAL, ON A LOG ENERGY SCALE, BETWEEN INPUT ENERGY POINTS.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - C. V. SMITH AND M. K. DRAKE, GAVER, A NEUTRON CROSS SECTION AVERAGING PROGRAM, GAMD-6692, SEPTEMBER 1, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

C. V. SMITH AND M. K. DRAKE
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P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

16. MATERIAL AVAILABLE -

SOURCE DECK (402 CARDS)
SAMPLE PROBLEM (164 CARDS)
REFERENCE REPORT

17. CATEGORY - L

KEYWORDS - MULTIGROUP CROSS SECTIONS, AVERAGES, GAM2 CODES LIBRARIES, INPUT DATA PREPARATION

1. NAME OR DESIGNATION OF PROGRAM - GAROL
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - GAROL COMPUTES EFFECTIVE GROUP CROSS SECTIONS FOR THE RESOLVED RESONANCES OF A MIXTURE OF ISOTOPES IN A TWO-REGION CELL. BASIC CROSS SECTIONS INCLUDE TEMPERATURE DEPENDENCE. THE PROGRAM ALLOWS A CHOICE OF GEOMETRIES AND CAN ACCEPT AN ARBITRARY TABLE OF ESCAPE PROBABILITIES. A DANCOFF CORRECTION MAY BE USED TO ACCOUNT FOR SHADOWING EFFECTS IN A TIGHT LATTICE, AND CROSS SECTIONS MAY BE $1/v$, CONSTANT, COMPUTED FROM BREIT-WIGNER RESONANCE PARAMETERS, OR GIVEN IN TABULAR FORM. THE MESH MAY BE CHOSEN AT EQUAL ENERGY OR LETHARGY INTERVALS, PROPORTIONAL TO THE NEUTRON VELOCITY, OR AS AN ARBITRARY TABLE OF VALUES.
4. METHOD OF SOLUTION - THE COLLISION PROBABILITY METHOD YIELDS TWO COUPLED INTEGRAL EQUATIONS WHICH ARISE FROM A NEUTRON BALANCE IN EACH REGION. THESE ARE SOLVED NUMERICALLY TO OBTAIN THE FLUX SPECTRUM IN EACH REGION, AS WELL AS GROUP CROSS SECTIONS FOR EACH REGION AND FOR THE CELL.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
NUMBER OF NUCLIDES EQUAL TO OR LESS THAN 10.
NUMBER OF RESONANCES PER ISOTOPE EQUAL TO OR LESS THAN 500.
TOTAL NUMBER OF RESONANCES FOR ALL ISOTOPES EQUAL TO OR LESS THAN 600.
NUMBER OF REGIONS EQUAL TO OR LESS THAN 2.
6. TYPICAL RUNNING TIME - VARIES CONSIDERABLY FROM PROBLEM TO PROBLEM. WITH 2 ISOTOPES, U235 AND H, AND 6600 ENERGY POINTS COVERING THE ENERGY RANGE, 0.5 EV TO 950 EV, THE RUNNING TIME WAS 3 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - OVERLAP OF RESONANCES OF AN INDIVIDUAL RESONANCE ABSORBER AND OF MIXTURES OF DIFFERENT RESONANCE ABSORBERS IS TREATED EXACTLY. SLOWING DOWN IN ALL ISOTOPES IS COMPUTED EXACTLY, SO THAT THE NR APPROXIMATION NEED NOT BE MADE FOR A HEAVY MODERATOR. OPTIONS PERMIT THE AUTOMATIC PLOTTING ON AN SC-4020 RECORDER OF FLUXES, CROSS SECTIONS, COLLISION DENSITY AND REACTION RATES.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - C. A. STEVENS AND C. V. SMITH, GAROL, A COMPUTER PROGRAM FOR EVALUATING RESONANCE ABSORPTION INCLUDING RESONANCE OVERLAP, GA-6637, AUGUST 24, 1965.

11. MACHINE REQUIREMENTS - 32K IBM7044. IF PLOTTING IS DESIRED, AN SC-4020 RECORDER IS NEEDED.
12. PROGRAMMING LANGUAGES USED - FORTRAN IV (90 PER CENT)
MAP (10 PER CENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
A CROSS SECTION TAPE GENERATED IN A GAROL RUN CAN BE USED IN
SUBSEQUENT RUNS.
15. NAME AND ESTABLISHMENT OF AUTHORS -
C. A. STEVENS AND C. V. SMITH
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2727 CARDS)
SAMPLE PROBLEM (32 CARDS)
REFERENCE REPORT
17. CATEGORY - B
KEYWORDS - RESOLVED REGION, BREIT-WIGNER FORMULA, RESONANCE PARA-
METERS, CELL CALCULATION, CROSS SECTIONS, DANCOFF COR-
RECTION, TEMPERATURE DISTRIBUTION, GRAPHS

REACTOR CODE ABSTRACT 220

10/67

1. NAME OR DESIGNATION OF PROGRAM - GASP2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - SOLVES FOR THE ONE-DIMENSIONAL DISTRIBUTION OF FISSILE AND FERTILE MATERIALS IN A NUCLEAR REACTOR WHICH WILL YIELD ANY DESIRED POWER DISTRIBUTION AND APPROXIMATELY RETAIN THIS DESIRED POWER DISTRIBUTION DURING THE BURN-UP HISTORY OF THE REACTOR CORE. A POISON AND POISON DISTRIBUTION SEARCH FOR A DESIRED MULTIPLICATION AND MINIMUM POWER DISTRIBUTION PERTURBATION CAN ALSO BE PERFORMED.
4. METHOD OF SOLUTION - A FEW-GROUP, ONE-DIMENSIONAL DIFFUSION THEORY CALCULATION IS PERFORMED WITH AN ASSUMED FISSILE AND FERTILE FUEL DISTRIBUTION. AN ITERATIVE SCHEME IS EMPLOYED TO ADJUST THE FISSILE DISTRIBUTION TO ACHIEVE THE DESIRED POWER DISTRIBUTION AND TO ADJUST THE FERTILE DISTRIBUTION TO ACHIEVE A BURNUP INDEPENDENT POWER DISTRIBUTION. THE POISON AND POISON DISTRIBUTION SEARCH IS PERFORMED BY AN ITERATIVE SCHEME WHICH MAINTAINS THE SAME DISTRIBUTION AS IN THE UNPOISONED CORE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
GEOMETRY ASSUMED IS CYLINDRICAL, EITHER RADIAL OR AXIAL FLUX DISTRIBUTIONS MAY BE CALCULATED.
MAXIMUM NUMBER OF ENERGY GROUPS = 4
MAXIMUM NUMBER OF THERMAL NEUTRON ENERGY GROUPS = 2
MAXIMUM NUMBER OF MESH POINTS = 100
MAXIMUM NUMBER OF REGIONS = 20
MAXIMUM NUMBER OF DIFFERENT MATERIALS IN EACH REGION = 35
MAXIMUM NUMBER OF DIFFERENT CROSS SECTION SETS = 60
6. TYPICAL RUNNING TIME - 2 TO 8 MINUTES IS TYPICAL.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - THE INPUT, OUTPUT, DIFFUSION CALCULATION AND OTHER ROUTINES OF THIS PROGRAM ARE VERY SIMILAR TO THE RELOAD FEVER CODE (ACC ABSTRACT 221).
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - W. A. SIMON AND K. R. VAN HOWE, GASP-II, A COMPUTER CODE FOR BURNUP-INDEPENDENT POWER SHAPING BY FUEL ZONING INCORPORATING A POISON SEARCH, GA-6689, OCTOBER 11, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
W. A. SIMON AND K. R. VAN HOWE
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3820 CARDS)
SAMPLE PROBLEM (482 CARDS).
REFERENCE REPORT
17. CATEGORY - C
KEYWORDS - POWER DISTRIBUTION SEARCHES, DIFFUSION EQUATIONS, 1-
DIMENSIONAL, FEW-GROUP, CYLINDERS, FUELS DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - RELOAD FEVER
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - A FEW-GROUP, 1-D DEPLETION CALCULATION WHICH ALLOWS FUEL IN VARIOUS STAGES OF IRRADIATION TO BE HOMOGENIZED INTO THE SAME REGION FOR PURPOSES OF THE DIFFUSION CALCULATION BUT FOLLOWS THE DEPLETION OF EACH OF THE SUB-REGIONS SEPARATELY. THE CALCULATION MAY BE INTERRUPTED PERIODICALLY FOR REFUELING ONE OR MORE REGIONS. RECYCLING IS OPTIONAL AND THERE IS NO LIMIT TO THE NUMBER OF REFUELINGS WHICH MAY BE PERFORMED. A CONTROL POISON SEARCH IS AVAILABLE AND CONCENTRATION DEPENDENT SELF-SHIELDING FACTORS MAY BE APPLIED TO ONE LUMPED POISON.
4. METHOD OF SOLUTION - FLUX DISTRIBUTION AND MULTIPLICATION FACTORS ARE COMPUTED BY MEANS OF A FEW-GROUP DIFFUSION ROUTINE. THE DEPLETION CALCULATIONS ARE PERFORMED ASSUMING THAT THE FLUX AMPLITUDE, SPECTRUM AND SPATIAL DISTRIBUTION REMAIN CONSTANT FOR SHORT TIME-STEPS. THE FLUX IN THE THERMAL GROUP IS RENORMALIZED TO THE POWER PRIOR TO EACH SHORT TIME-STEP AND THE SPECTRUM IS RECALCULATED AFTER A SPECIFIED SERIES OF SHORT TIME-STEPS. FOR THE BURN-UP, NUCLIDES BELONGING TO EACH SUBREGION REACT TO THE AVERAGE FLUXES PRESENT IN THE REGION TO WHICH THE SUB-REGION IS ASSIGNED. THE DIFFUSION CALCULATION IS PERFORMED USING FEW-GROUP CONSTANTS WHICH ARE VOLUME-WEIGHTED PROPERTIES OF ONE OR MORE SUB-REGIONS HOMOGENIZED INTO A DIFFUSION REGION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF ENERGY GROUPS = 4
 - MAXIMUM NUMBER OF MESH POINTS = 100
 - MAXIMUM NUMBER OF REGIONS = 20
 - MAXIMUM NUMBER OF SUB-REGIONS = 32
 - MAXIMUM NUMBER OF NUCLIDES PER SUB-REGION = 35
 - FIXED SETS OF HEAVY NUCLIDES
6. TYPICAL RUNNING TIME - 18 SECONDS, DEPENDING MAINLY UPON NUMBER OF DIFFUSION CALCULATIONS REQUIRED
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - THIS CODE IS AN EXTENSION OF METHODS USED IN THE FEVER (ACC ABSTRACT 117) AND THE GAD CODE (GA-2749).
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - F. TODT, RELOAD FEVER, A ONE-DIMENSIONAL, FEW GROUP DEPLETION PROGRAM FOR REACTOR FUEL CYCLE ANALYSIS, GA-6612, SEPTEMBER 18, 1965.

11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
F. W. TOOT
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (4677 CARDS)
SAMPLE PROBLEM (235 CARDS)
REFERENCE REPORT
17. CATEGORY - D
KEYWORDS - DEPLETION, DIFFUSION EQUATIONS, 1-DIMENSIONAL, FEW-GROUP, FUEL CYCLE

1. NAME OR DESIGNATION OF PROGRAM - GAMBLE4
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - STEADY-STATE TWO-DIMENSIONAL SOLUTION FOR THE MULTIGROUP NEUTRON DIFFUSION EQUATIONS WITH ARBITRARY GROUP-TO-GROUP ENERGY COUPLING.
4. METHOD OF SOLUTION - THE PROGRAM USES AN EXTENSION OF THE POWER METHOD TO FIND THE EIGENVECTOR (NEUTRON FLUX) AND THE VALUE OF K-EFFECTIVE. AN EXTENSION OF SUCCESSIVE OVERRELAXATION WITH A VARIABLE (POINTWISE AND GROUPLISE) OVERRELAXATION FACTOR IS USED TO EXECUTE POWER ITERATIONS WITH A POWER MATRIX WHICH IS A FUNCTION OF THE CURRENT K-EFFECTIVE ESTIMATE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF DIFFERENT MATERIAL REGIONS = 300
MAXIMUM NUMBER OF GROUPS = 10
MAXIMUM NUMBER OF MESH POINTS = 20,000
THE SOLUTION IS ACHIEVED OVER A NON-UNIFORM MESH WITH X-Y OR R-Z GEOMETRY.
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM - WHILE PERHAPS NOT UNUSUAL, THE CODE PROVIDES -
(A) ITERATIONS FOR WHICH THERE IS VIRTUALLY NO DELAY CAUSED BY THE USE OF MAGNETIC TAPE STORAGE,
(B) ABILITY TO DO EFFICIENT RESTARTS OF A PROBLEM RUN, AND
(C) ABILITY TO ACCEPT A FLUX TAPE GUESS FROM A SIMILAR PROBLEM.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - J. P. DORSEY, GAMBLE-4, A PROGRAM FOR THE SOLUTION OF THE MULTIGROUP NEUTRON DIFFUSION EQUATIONS IN TWO DIMENSIONS, WITH ARBITRARY GROUP SCATTERING, FOR THE IBM7044 FORTRAN IV SYSTEM, GA-6540, JULY 1, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044 WITH 11 TAPE UNITS ON TWO DATA CHANNELS AND A PERIPHERAL PRINTER
12. PROGRAMMING LANGUAGES USED - FORTRAN IV IS USED WITH THE ONLY SIGNIFICANT EXCEPTION BEING A COMPLEX TAPE READ-WRITE ROUTINE WRITTEN IN MAP LANGUAGE.

REACTOR CODE ABSTRACT 222

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13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
USE OF PREVIOUS SOLUTION AS INPUT AND EFFICIENT RESTART PROCEDURE
REQUIRES AN ADDITIONAL TAPE UNIT.
15. NAME AND ESTABLISHMENT OF AUTHOR -
JOHN P. DORSEY
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (19632 CARDS)
SOURCE DECK
BINARY DECK
SAMPLE PROBLEM
REFERENCE REPORT
17. CATEGORY - C
KEYWORDS - DIFFUSION EQUATIONS, 2-DIMENSIONAL, MULTIGROUP, X-Y,
R-Z, REACTIVITY, FLUX DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - REVISED GAD
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS INFINITE-MEDIUM DEPLETION PROGRAM PERFORMS FUEL CYCLE CALCULATIONS ON REACTORS EMPLOYING PARTIAL REFUELING. THE BURN-UP OF UP TO 12 DISCRETE FUEL COMPOSITIONS (REGIONS OR STAGES OF IRRADIATION) MAY BE FOLLOWED SIMULTANEOUSLY. THE BURN-UP CALCULATION MAY BE INTERRUPTED PERIODICALLY TO REMOVE THE CONTENTS AND TO REFUEL ONE OR MORE REGIONS. FUEL MAY BE PARTIALLY OR COMPLETELY RECYCLED.
4. METHOD OF SOLUTION - ALL REGIONS ARE ASSUMED TO BE SUBJECTED TO THE SAME NEUTRON FLUX AND THE DEPLETION CALCULATIONS ARE PERFORMED WITH A SERIES OF SHORT TIME-STEPS. AFTER EACH TIME-STEP THE FLUX AMPLITUDE IS RENORMALIZED TO THE POWER AND THE SPECTRUM MAY BE RECALCULATED AFTER A SPECIFIED SERIES OF THESE STEPS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF ENERGY GROUPS = 15
 - MAXIMUM NUMBER OF FUEL COMPOSITIONS OR REGIONS = 12
 - MAXIMUM NUMBER OF NUCLIDES PER REGION = 35
 - MAXIMUM NUMBER OF MODERATOR NUCLIDES WITH THERMAL TRANSFER MATRIX = 3.
 - 2 FIXED HEAVY NUCLIDE CHAINS ARE ALWAYS PRESENT
6. TYPICAL RUNNING TIME - 1 TO 3 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM - THIS PROGRAM IS USEFUL IN STUDYING THE APPROACH TO EQUILIBRIUM FUEL CYCLE.
8. RELATED AND AUXILIARY PROGRAMS - THIS CODE IS A SIMPLIFIED VERSION OF THE GAD CODE (GA-4150) WHICH RUNS ABOUT 4 TIMES LONGER BUT CONTAINS VARIABLE SHIELDING FACTORS, CONTROL SEARCHES, AND COST CALCULATIONS. CARDS MAY BE PUNCHED AT EACH TIME-STEP IN A FORMAT ACCEPTABLE TO THE WAMPUM FUEL CYCLE COST CODE (ACC ABSTRACT 224).
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - F. W. TODT, REVISED GAD, AN INFINITE MEDIUM DEPLETION PROGRAM FOR REACTOR FUEL CYCLE ANALYSIS, GA-6635, NOVEMBER 10, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV

REACTOR CODE ABSTRACT 223

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10/67

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
F. W. FOOT
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2811 CARDS)
SAMPLE PROBLEM (482 CARDS)
REFERENCE REPORT
17. CATEGORY - D
KEYWORDS - FUEL CYCLE, DEPLETION, INFINITE MEDIA

REACTOR CODE ABSTRACT 224

10/67

1. NAME OR DESIGNATION OF PROGRAM - WAMPUM
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM CALCULATES FUEL CYCLE COSTS ON A DETAILED BASIS, USING RESULTS OF NUCLEAR DEPLETION CALCULATIONS AND CERTAIN SPECIFIED ECONOMICS ASSUMPTIONS. THE PURPOSE IS TO PROVIDE A MEASURE OF PERFORMANCE FOR COMPARING OR OPTIMIZING FUEL CYCLES AND ASSOCIATED REACTOR CORE AND FUEL ELEMENT CHARACTERISTICS.
4. METHOD OF SOLUTION - FOLLOWS PROCEDURE SIMILAR TO THAT OUTLINED IN GUIDE TO NUCLEAR POWER COST EVALUATION, TID-7025, VOLUME 4, WITH SOME MODIFICATION TO PROVIDE MORE GENERALITY IN APPLICATION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - LESS THAN 1 MINUTE IS REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
 - (A) BOTH GOVERNMENT AND PRIVATE FUEL OWNERSHIP CONSIDERED.
 - (B) CAPITAL COSTS OF FUEL CYCLE OPERATIONS ARE EVALUATED DIRECTLY, BY APPLYING AN INTEREST RATE TO THE FABRICATION COST AND INVENTORY VALUE, AND IMPLICITLY, BY HOLDING CONSTANT THE PRESENT VALUE OF EACH COST ITEM OVER THE IRRADIATION PERIOD.
 - (C) PROVISION IS MADE FOR DISTINGUISHING BETWEEN FED AND BRED FUEL.
 - (D) TWO FUEL PARTICLE TYPES HAVING DIFFERENT ENRICHMENTS CAN BE ACCOMMODATED WHICH PERMITS CALCULATIONS INVOLVING SEGREGATED FUEL.
8. RELATED AND AUXILIARY PROGRAMS - REVISED GAD (ACC ABSTRACT 223)
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - F. W. TODD AND J. R. TRIPLETT, A GENERAL FUEL CYCLE ECONOMICS CODE, GA-5316, OCTOBER 27, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

REACTOR CODE ABSTRACT 224

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15. NAME AND ESTABLISHMENT OF AUTHORS -

F. W. TODD AND J. R. TRIPLET
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

16. MATERIAL AVAILABLE -

SOURCE DECK (1009 CARDS)
SAMPLE PROBLEM (62 CARDS)
REFERENCE REPORT

17. CATEGORY - D

KEYWORDS - FUEL CYCLE ECONOMICS, DEPLETION, PERFORMANCE, FUEL
ELEMENTS

REACTOR CODE ABSTRACT 225

10/67

1. NAME OR DESIGNATION OF PROGRAM - TEMCO
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - TEMCO COMPUTES REACTOR TEMPERATURE COEFFICIENTS.
4. METHOD OF SOLUTION - GIVEN CROSS SECTIONS FOR EACH TEMPERATURE TO BE CONSIDERED, THE CODE PERFORMS A SERIES OF ONE-DIMENSIONAL DIFFUSION CALCULATIONS AND THEN USES THE RESULTS TO GENERATE THE TEMPERATURE COEFFICIENT.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA ALLOWED ARE
 - 25 TEMPERATURES
 - 4 ENERGY GROUPS
 - 20 REGIONS
 - 100 MESH POINTS
 - 32 SUBREGIONS
 - 40 NUCLIDES PER SUBREGION
 - 120 CROSS SECTION SETS PER TEMPERATURE
6. TYPICAL RUNNING TIME - DEPENDS UPON NUMBER OF TEMPERATURES AND THE CONVERGENCE OF THE DIFFUSION CALCULATIONS. A REALISTIC TIME ESTIMATE FOR A TYPICAL CASE IS 14.4 SECONDS PER TEMPERATURE.
7. UNUSUAL FEATURES OF THE PROGRAM - COMPUTES TEMPERATURE DERIVATIVES OF THE FOUR FACTORS η , ϵ , ρ , k , AND THE CONTRIBUTIONS OF EACH NUCLIDE TO THE TEMPERATURE COEFFICIENT.
8. RELATED AND AUXILIARY PROGRAMS - TEMCO USES THE SAME DIFFUSION CALCULATION AS RELOAD FEVER (ACC ABSTRACT 221).
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - F. W. TODT, TEMCO, A FORTRAN PROGRAM FOR COMPUTING TEMPERATURE COEFFICIENTS, GA-6734, DECEMBER 28, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

F. W. TODT
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2192 CARDS)
SAMPLE PROBLEM (175 CARDS)
REFERENCE REPORT

17. CATEGORY - C

KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, FEW-GROUP, TEMPERATURE COEFFICIENTS

REACTOR CODE ABSTRACT 226

10/67

1. NAME OR DESIGNATION OF PROGRAM - OPUS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE CODE GENERATES A FLOW NETWORK EQUIVALENT TO A GAS-COOLED NUCLEAR POWER PLANT OF SPECIFIED ELECTRICAL OUTPUT (IN THE RANGE OF 100 TO 1000 MW) ACCORDING TO INPUT DATA AND PROGRAMMED RULES, PROCEEDS TO EVALUATE THE PLANT PERFORMANCE AND PRICE OF THE TURBOGENERATOR SET (ACCORDING TO GENERAL ELECTRIC PRICE DATA), AND PRINTS AS A RESULT A CODED LIST OF ALL PLANT COMPONENTS AND A DETAILED PERFORMANCE MAP.
4. METHOD OF SOLUTION - THE PROGRAM SETS UP A SPARSE MATRIX REPRESENTING THE FLOW OF MASS AND ENERGY IN THE SYSTEM AND SOLVES THE CORRESPONDING SET OF LINEAR EQUATIONS REPEATEDLY, THUS ACCOUNTING FOR NONLINEAR EFFECTS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - POWER LEVELS FROM 100 TO 1000 MEGAWATTS ARE ACCEPTABLE. A MAXIMUM OF 100 TURBO-GENERATOR ARRANGEMENTS CAN BE INCLUDED. SYSTEMS UP TO 100 NODES LEADING TO NO MORE THAN 749 EQUATIONS CAN BE STUDIED.
6. TYPICAL RUNNING TIME - A 300 MW SYSTEM IS GENERATED AND ANALYZED IN ABOUT 1.8 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - F. S. FREUDIGER AND J. E. GRATTEAU, OPUS, A POWER PLANT PERFORMANCE ANALYSIS PROGRAM, GAMO-6674, AUGUST 27, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, INPUT AND OUTPUT TAPES PLUS 5 TAPES.
12. PROGRAMMING LANGUAGE USED - FORTRAN IV AND NOMINAL MAP ROUTINES
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

F. S. FREUDIGER AND J. E. GRATTEAU
GULF GENERAL ATOMIC INCORPORATED
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SAN DEIGO, CALIFORNIA 92112

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (11349 CARDS)
SAMPLE PROBLEM (39 CARDS)
REFERENCE REPORT

17. CATEGORY - D

KEYWORDS - GAS COOLANT, POWER PLANT PERFORMANCE, ECONOMICS

REACTOR CODE ABSTRACT 227 10/67

1. NAME OR DESIGNATION OF PROGRAM - STMGEN
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - STMGEN WILL BE USED IN A PLANT OPTIMIZATION PROGRAM. THIS CODE DETERMINES THE AREA OF EACH SECTION OF A STEAM GENERATOR REQUIRED TO SATISFY THE DESIGN CONDITIONS OF HEAT TRANSFER, PRESSURE DROP AND MAXIMUM TUBE TEMPERATURE CONSTRAINTS. THE COST OF THE GENERATOR IS COMPUTED AS A FUNCTION OF THE TOTAL HEAT TRANSFER AREA, THE NON-PRODUCTIVE TUBE LENGTH REQUIRED TO CONNECT THE HEADERS, PLUS THE COST OF THE HEADERS.
4. METHOD OF SOLUTION - COST DATA USED IS BASED ON VENDOR ESTIMATES OF STEAM GENERATORS OF THIS TYPE AND MANUFACTURERS TUBE COST DATA.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE STEAM GENERATOR MAY BE COMPOSED OF UP TO 10 SECTIONS WITH UP TO 20 AXIAL INCREMENTS IN EACH SECTION. THE HEAT TRANSFER ANALYSIS IS CAPABLE OF HANDLING EITHER CROSS OR PARALLEL HELIUM FLOW, ALTHOUGH THE HEAT TRANSFER FILM COEFFICIENT AND HELIUM PRESSURE DROP CORRELATIONS ARE USED FOR CROSS FLOW ONLY.
6. TYPICAL RUNNING TIME - 2 TO 3 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - THE POWER PLANT PERFORMANCE ANALYSIS IN THE GA OPTIMIZATION PROGRAM IS PERFORMED BY THE OPUS PROGRAM (ACC ABSTRACT 226).
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCES - G. M. SCHULTZ AND D. A. DOERING, STMGEN, A COMPUTER CODE FOR THE DESIGN OF A STEAM GENERATOR, GAMD-6675, AUGUST 27, 1965, AND SUPPLEMENT.
ENGINEERING PROGRAM ABSTRACTS FOR - SUBROUTINE TBLOAD, PROGRAM TBLGEN, AND SUBROUTINE LUKUP2.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

G. M. SCHULTZ AND D. A. DOERING
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECK (2876 CARDS)

SAMPLE PROBLEMS (375 CARDS)

REFERENCE REPORT AND SUPPLEMENT, AND ENGINEERING PROGRAM
ABSTRACTS

17. CATEGORY - D

KEYWORDS - STEAM GENERATORS, DESIGN, POWER PLANT PERFORMANCE,
ECONOMICS, HEAT TRANSFER, TEMPERATURE, PRESSURE

REACTOR CODE ABSTRACT 228

10/67

1. NAME OR DESIGNATION OF PROGRAM - PRECON
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PURPOSE OF THE PROGRAM IS TO DETERMINE, FOR A GAS-COOLED REACTOR, THE CONTAINMENT PRESSURE AS A FUNCTION OF TIME, AFTER RUPTURES HAVE BEEN ASSUMED TO OCCUR IN THE PRIMARY SYSTEM OR IN CONJUNCTION WITH STEAM GENERATOR RUPTURES.
4. METHOD OF SOLUTION - AN HTGR SYSTEM IS SUBDIVIDED INTO THREE VOLUMES, THE STEAM GENERATOR, THE PRIMARY SYSTEM, AND THE CONTAINMENT. FOR EACH TIME-STEP MASS AND ENERGY EQUATIONS ARE SOLVED TO OBTAIN TEMPERATURE AND PRESSURE DATA, AND WATER-GAS INVENTORY IN EACH VOLUME.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - (A) THE PROGRAM CANNOT HANDLE SUPER-CRITICAL STEAM GENERATORS.
 - (B) ONLY VERY LARGE OR VERY SMALL RUPTURES CAN BE TREATED.
 - (C) MAXIMUM OF THREE WATER DUMP VALVES ALLOWED IN STEAM GENERATOR.
 - (D) INITIALLY, THE THREE VOLUMES ARE ASSUMED TO CONTAIN THE FOLLOWING - IN STEAM GENERATOR - WATER AND STEAM
IN PRIMARY SYSTEM - HELIUM
IN CONTAINMENT - NITROGEN
6. TYPICAL RUNNING TIME - THE PROGRAM COMPUTES APPROXIMATELY TEN TIME-STEPS IN 3 TO 4 SECONDS.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - THE PROGRAM USES THE GENERAL ELECTRIC STEAM TABLES ROUTINE MODIFIED BY J. E. GRATTEAU FOR THE IBM7044.
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - R. H. HANSEN, PRECON, A FORTRAN PROGRAM FOR COMPUTING CONTAINMENT PRESSURES, GAMD-6276, MARCH 31, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.

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14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. H. HANSEN
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (4419 CARDS)
STEAM TABLES ROUTINE (1336 CARDS)
REFERENCE REPORT
17. CATEGORY - G
KEYWORDS - HTGR REACTORS, CONTAINMENT PRESSURE, STEAM GENERATOR,
FAILURES, TIME DISTRIBUTION, TEMPERATURE, PRESSURE,
GASES, WATER

REACTOR CODE ABSTRACT 229

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1. NAME OR DESIGNATION OF PROGRAM - ELBOW
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - DEFLECTIONS, RESTRAINT FORCES AND STRESSES ARE DETERMINED IN A FUEL ELEMENT SUBJECTED TO ASYMMETRIC POWER GENERATION, CIRCUMFERENTIALLY NON-UNIFORM COOLANT TEMPERATURE DISTRIBUTION, AND ASYMMETRIC FAST NEUTRON FLUX DAMAGE.
4. METHOD OF SOLUTION - THE FUEL ELEMENT IS ASSUMED TO BE A BEAM HAVING THE SAME CROSS SECTION ALONG THE ENTIRE LENGTH. THE ELEMENT IS FIXED AT ONE END (CANTILEVER BEAM) AND RESTRAINED FROM DEFLECTING AT A FINITE NUMBER OF POINTS. THE SURROUNDINGS ARE TAKEN AS BEING RIGID AND CLEARANCES MAY BE PRESCRIBED BETWEEN THE ELEMENT AND THE SURROUNDINGS. THE DIFFERENTIAL STRAINS ARE ASSUMED TO BE LINEAR THROUGH THE CROSS SECTION OF THE ELEMENT (BEAM THEORY) AND ARE FOUND AT A FINITE NUMBER OF AXIAL POINTS. THE UNRESTRAINED DEFLECTION IS FOUND DUE TO THE EFFECTS OF TEMPERATURE, FAST FLUX DAMAGE, AND CREEP RELAXATION. FORCES REQUIRED TO RESTRAIN THE ELEMENT WITHIN THE CLEARANCE BAND BETWEEN THE ELEMENT AND SURROUNDINGS ARE FOUND BY AN ITERATION PROCEDURE. STRESSES ARE COMPOSED OF ELASTIC STRESSES DUE TO THE FORCE DISTRIBUTION AND STRESSES DUE TO CREEP. THE DEFLECTION DUE TO TEMPERATURE GRADIENTS IS CONSTANT WITH TIME WHILE THE DEFLECTION DUE TO THE FLUX DAMAGE AND CREEP RELAXATION DEPEND ON THE EXPOSURE TIME. DIFFERENTIAL STRAINS DUE TO FAST FLUX DAMAGE ARE FOUND AS A FUNCTION OF EXPOSURE AND TEMPERATURE (DATA PROVIDED BY INPUT TABLE). THE EFFECT OF CREEP IS A FUNCTION ONLY OF THE STRESS LEVEL AND IS EXPRESSED BY A POWER LAW.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THERE ARE A MAXIMUM OF 25 FORCE RESTRAINT POINTS.
DEFLECTIONS CAN BE CALCULATED AT A MAXIMUM OF 50 AXIAL POINTS.
STRESSES CAN BE CALCULATED AT A MAXIMUM OF 25 POINTS THROUGH THE CROSS SECTION.
THE ELEMENT GEOMETRY IS PRESENTLY LIMITED TO CONCENTRIC-RING FUEL ELEMENTS, HEXAGONAL REFLECTOR ELEMENTS, DUAL-DIAL FUEL ELEMENTS COOLED ON THE INNER AND OUTER SURFACES, AND THE SINGLE-DIAL FUEL ELEMENTS COOLED ON THE OUTER SURFACE.
6. TYPICAL RUNNING TIME - 1 TO 2 MINUTES IS REQUIRED FOR A SAMPLE PROBLEM WITH 30 AXIAL AND 20 RADIAL DIVISIONS, 3 AXIAL RESTRAINT POINTS, AND 5 TIME-STEPS.
7. UNUSUAL FEATURES OF THE PROGRAM - OPTIONS ARE AVAILABLE TO TREAT THE EFFECTS OF IRRADIATION-INDUCED CREEP, FINITE CLEARANCES BETWEEN NEIGHBORING ELEMENTS, AND THE CASE WHERE THE ELEMENT IS ROTATED 180 DEGREES AT A GIVEN TIME DURING THE REACTOR LIFETIME.
8. RELATED AND AUXILIARY PROGRAMS -

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9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - R. KATZ, ELBOW, FUEL ELEMENT BOWING CODE, GAMD-6334
1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT,
SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. KATZ
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (4201 CARDS)
SAMPLE PROBLEM (24 CARDS)
REFERENCE REPORT
17. CATEGORY - G
KEYWORDS - FUEL ELEMENTS, STRESSES, DEFORMATION, FAST NEUTRONS,
TEMPERATURE, COOLANTS

REACTOR CODE ABSTRACT 230

10/67

1. NAME OR DESIGNATION OF PROGRAM - PIZZA
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS CODE USES A NUMERICAL METHOD TO CALCULATE THE DEFORMATION AND RESULTING STRESS DISTRIBUTION OF TWO-DIMENSIONAL BODIES UNDER PLANE STRESS CONDITIONS. PIZZA IS INTENDED AS A RAPID AND FLEXIBLE DESIGN TOOL IN WHICH THE MATERIAL CONSTANTS, DIMENSIONS, AND LOADING CONDITIONS MAY BE READILY ALTERED. THIS CODE IS PARTICULARLY APPLICABLE TO THE SOLUTION OF IRREGULARLY-SHAPED PLANE BODIES WHICH DO NOT HAVE EITHER AN EXACT OR AN APPROXIMATE MATHEMATICAL SOLUTION.
4. METHOD OF SOLUTION - THE METHOD EMPLOYS THE CONCEPT OF STIFFNESS COEFFICIENTS, BASIC ASSUMPTIONS OF ELASTICITY, AND THE MAXWELL RECIPROCAL THEOREM. THE PROBLEM IS DESCRIBED AS AN ASSEMBLAGE OF FINITE SUBREGIONS FOR WHICH THE DEFORMATION FUNCTION CAN BE DEFINED OR ASSUMED. THE RESULTING SYSTEM IS SOLVED UNDER COMPATIBILITY AND EQUILIBRIUM REQUIREMENTS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
ONLY TWO-DIMENSIONAL BODIES ARE TREATED BY PIZZA, AND PLANE STRESS IS ASSUMED.
DEFORMATIONS MUST BE SMALL, THAT IS, WITHIN THE ELASTIC LIMIT.
MAXIMUM OF 234 DISPLACEMENT COMPONENTS (BEFORE CONSTRAINTS).
MAXIMUM OF 225 ELEMENTS.
MAXIMUM OF 100 NODE CARDS (AT LEAST 100 NODES).
MAXIMUM OF 80 LINEAR CONSTRAINT CARDS.
6. TYPICAL RUNNING TIME - 46 TO 47 SECONDS ARE REQUIRED FOR 75 EQUATIONS, AND 26 TO 67 MINUTES FOR 475 EQUATIONS.
7. UNUSUAL FEATURES OF THE PROGRAM - THE PIZZA PROGRAM IS CAPABLE OF ANALYZING PLANE CONCRETE STRUCTURES REINFORCED WITH UNIAXIAL BARS.
8. RELATED AND AUXILIARY PROGRAMS - TARGET, A 3-DIMENSIONAL CODE SIMILAR IN METHOD, (GAMD-5001).
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCES - O. C. CORNELL, PIZZA, AN IBM COMPUTER CODE FOR THE PLANE STRESS ANALYSIS OF TWO-DIMENSIONAL BODIES--INPUT INSTRUCTIONS, GAMD-5239, AUGUST 17, 1964.
M. J. TURNER, ET AL., STIFFNESS AND DEFLECTION ANALYSIS OF COMPLEX STRUCTURES, JOURNAL OF THE APPLIED AERONAUTICAL SCIENCES, VOL. 25, NO. 9, SEPTEMBER 1956.
11. MACHINE REQUIREMENTS - FULL CORE OF IBM7044 FOR 6 LINKS WITH 2 EXTERNAL TAPES

12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
D. C. CORNELL
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (7044-4935 CARDS)
SAMPLE PROBLEM (7044-209 CARDS)
REFERENCE REPORT, GAMD-5239
17. CATEGORY - 1
KEYWORDS - DEFORMATION, STRESS DISTRIBUTION, 2-DIMENSIONAL, DESIGN, ELASTICITY, STRUCTURAL ANALYSIS

REACTOR CODE ABSTRACT 231

10/67

1. NAME OR DESIGNATION OF PROGRAM - RAD2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - THIS PROGRAM CALCULATES THE FISSION PRODUCT ACTIVITY DISTRIBUTIONS IN A HIGH TEMPERATURE GAS-COOLED REACTOR SYSTEM.
4. METHOD OF SOLUTION - RAD2 USES RELEASE FRACTION INPUT INFORMATION OR ALTERNATIVELY A RELEASE FRACTION CALCULATED FROM AN INPUT DIFFUSION PARAMETER, ASSUMING DIFFUSE RELEASE TO COMPUTE THE FISSION PRODUCT INVENTORY AS A FUNCTION OF FISSION POWER, OPERATING TIME, AND SYSTEM DELAY TIME PERFORMING A VARIETY OF BOOKKEEPING CALCULATIONS ON THE RADIOACTIVE FISSION PRODUCT DECAY CHAINS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - THE SAMPLE PROBLEM REQUIRED APPROXIMATELY 25 SECONDS.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - F. E. VANSLAGER, RAD-2, A COMPUTER PROGRAM FOR CALCULATING FISSION PRODUCT RADIOACTIVITIES, GAMD-6519, JULY 23, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
F. VANSLAGER
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

REACTOR CODE ABSTRACT 231

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16. MATERIAL AVAILABLE -
SOURCE DECK (250 CARDS)
SAMPLE PROBLEM (184 CARDS)
REFERENCE REPORT
17. CATEGORY - D
KEYWORDS - FISSION PRODUCTS, HTGR REACTORS, RADIOACTIVITY

REACTOR CODE ABSTRACT 232

10/67

1. NAME OR DESIGNATION OF PROGRAM - GAZELLE5
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - DETERMINATION OF GAS-COOLED FAST REACTOR CORE PROPORTIONS REQUIRED TO SATISFY SPECIFIED DESIGN CONSTRAINTS AND COMPUTATION OF RESULTING PERFORMANCE CHARACTERISTICS.
4. METHOD OF SOLUTION - COMBINATION OF HEAT TRANSFER, FLOW AND GEOMETRICAL RELATIONSHIPS WITH IMPOSED DESIGN REQUIREMENTS AND NUCLEAR DATA SUPPLIED AS INPUT IN THE FORM OF THE NECESSARY FUEL VOLUME FRACTION AND FISSILE DENSITY.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE CODE IS USABLE FOR ANY REACTOR SYSTEM EMPLOYING ROUND ROD FUEL ELEMENTS INCORPORATING WITHIN THEMSELVES ALL FISSILE, FERTILE, AND DILUENT MATERIAL USED IN THE CORE.
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM - THE PROGRAM ALLOWS USE OF AN ARBITRARY DEGREE OF SURFACE ROUGHENING OVER ALL, OR A PORTION OF THE ELEMENTS, AND CAN DESIGN FOR OPTIONAL DISTRIBUTION OF SUCH ROUGHENING.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - P. FORTESCUE, GAZELLE V, A CODE FOR THE THERMAL DESIGN OF HOMOGENEOUS GAS-COOLED REACTORS, GAMD-6754, DECEMBER 1, 1965.
11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
PETER FORTESCUE
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

REACTOR CODE ABSTRACT 232

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16. MATERIAL AVAILABLE -
SOURCE DECK (1246 CARDS)
SAMPLE PROBLEM (17 CARDS)
REFERENCE REPORT
17. CATEGORY - 1
KEYWORDS - DESIGN, PERFORMANCE, FAST REACTORS, GAS COOLANTS,
HOMOGENEOUS

REACTOR CODE ABSTRACT 233

10/67

1. NAME OR DESIGNATION OF PROGRAM - CORE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE REACTOR CORE CONFIGURATION DESIGNED BY THE CORE PROGRAM CONSISTS OF CYLINDRICAL FUEL ELEMENTS ARRANGED ON AN EQUILATERAL PITCH SPACING WITH INTERNAL AND EXTERNAL COOLING. THE FUEL ELEMENT IS COMPOSED OF THREE CONCENTRIC GRAPHITE RINGS, AN INTERNAL COOLANT CHANNEL, AND A SPINE. THE COOLANT CHANNEL IS FORMED BY THE SPINE AND INNER GRAPHITE RING. THE FUEL IS CONTAINED IN THE MIDDLE GRAPHITE RING. CORE WILL DETERMINE THE NUMBER OF FUEL ELEMENTS OF A SPECIFIED DIAMETER AND LENGTH REQUIRED TO SATISFY A GIVEN CENTRAL FUEL TEMPERATURE. IT ALSO ADJUSTS THE PITCH SPACING REQUIRED TO PRODUCE A DESIRED PRESSURE DROP AS WELL AS PROVIDING A SPECIFIED INTERNAL COOLING RATE.
4. METHOD OF SOLUTION - AN AVERAGE ELEMENT ANALYSIS IS USED TO DETERMINE THE PITCH SPACING AND THE DIAMETER OF THE SPINE REQUIRED TO SATISFY PRESSURE DROP AND RELATIVE EXIT CONSTRAINTS OF THE CORE. THE TEMPERATURE DIFFERENCE BETWEEN THE INNER AND OUTER FLOW CHANNELS IS CONTROLLED BY VARYING THE FLOW AREA OF THE INNER CHANNEL WITH THE CENTER SPINE AND THE DESIRED CORE PRESSURE DROP ATTAINED BY ADJUSTING THE FUEL ELEMENT PITCH SPACING. THE TEMPERATURE AND FLOW DISTRIBUTION FOR THE CHANNEL WITH THE MAXIMUM HEAT GENERATION RATE ARE DERIVED AS A FUNCTION OF THE GEOMETRY AND AVERAGE CHANNEL COMPUTATION. IF THE TEMPERATURE IS TOO HIGH, FUEL ELEMENTS ARE ADDED AND THE COMPUTATION REPEATED. WHEN ANALYSIS IS COMPLETED CORE VOLUME CAN BE DETERMINED FROM CORE LENGTH, NUMBER OF FUEL ELEMENTS, AND PITCH SPACING.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE ELEMENT MUST BE COMPOSED OF CIRCULAR ANNULAR FUEL ELEMENTS.
6. TYPICAL RUNNING TIME - 2 TO 3 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - CORE IS ONE OF A SERIES OF CODES TO BE USED FOR PLANT OPTIMIZATION. CARBON AND THORIUM ATOM DENSITIES CAN BE COMPUTED FROM THE CORE VOLUME AND THE DESIRED CARBON-THORIUM RATIO. THE REMAINING FUEL CYCLE PARAMETERS, AS WELL AS THE NUCLEAR DATA REQUIRED TO COMPUTE THE BURN-UP AND RESULTING FUEL CYCLE COSTS ARE INCLUDED IN THE INPUT TO THE BURN-UP AND FUEL CYCLE COST SUBROUTINES--TWO STANDARD GA PROGRAMS, GAFFEE (BURN-UP) AND WAMPUM (ACC ABSTRACT 2241).
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7044 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - G. M. SCHULTZ, CORE, A COMPUTER CODE FOR THE DESIGN OF A GAS-COOLED REACTOR CORE, GAMD-6676, AUGUST 27, 1965.

11. MACHINE REQUIREMENTS - 32K IBM7044, 3 TAPES (INPUT, OUTPUT, SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
G. M. SCHULTZ
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE -
SOURCE DECK (801 CARDS)
REFERENCE REPORT
17. CATEGORY - 1
KEYWORDS - FUEL ELEMENTS, DESIGN, GAS COOLANTS, TEMPERATURE, PRESSURE

REACTOR CODE ABSTRACT-234

10/67

1. NAME OR DESIGNATION OF PROGRAM - DPC
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - DPC PREPARES INPUT DATA FOR TWO-DIMENSIONAL NEUTRONIC CALCULATIONS FROM ENGINEERING DATA. A GENERAL DESCRIPTION OF REGIONS, IN TERMS OF MULTIPLE SUBREGIONS, ALLOWS FOR EXPLICIT CONSIDERATION OF DETAILED STRUCTURAL FORMS. DURING THE TRANSFORMATION OF DATA, GENERAL THERMAL EXPANSIONS ARE INCLUDED. ALSO, CONSIDERABLE DATA CHECKING AND EVALUATION ARE PERFORMED. COMBINED WITH THE FLEXIBLE NARRATIVE INPUT, THESE FEATURES MAKE THE CODE USEFUL IN THE PREPARATION OF ERROR-FREE INPUT FOR COMPLEX PROBLEMS.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - PRESENT VERSION IS LIMITED TO R-Z GEOMETRY.
6. TYPICAL RUNNING TIME - LESS THAN 1 MINUTE FOR MOST PROBLEMS.
7. UNUSUAL FEATURES OF THE PROGRAM - FLEXIBLE INPUT FORMAT AND EXTENSIVE ERROR CHECKING ARE PROVIDED. MULTIPLE PROBLEMS CAN BE EXECUTED IN SEQUENCE.
8. RELATED AND AUXILIARY PROGRAMS - THE DECIN INPUT ROUTINE IS USED. (M. F. MITCHELL, FLEXIBLE DECIMAL AND ALPHABETIC INPUT ROUTINE FOR FORTRAN-II, SHARE DISTRIBUTION 1469, 1963). OUTPUT ROUTINES PROVIDE INPUT FOR EITHER THE CRAM (ACC ABSTRACT 103) OR DDK PROGRAMS.
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7094 VERSION SUBMITTED FEBRUARY 1966.
10. REFERENCE - W. H. HANNUM AND B. M. CARMICHAEL, DPC, A TWO-DIMENSIONAL DATA PREPARATION CODE, LA-3427-MS, FEBRUARY 3, 1966.
11. MACHINE REQUIREMENTS - 32K CORE STORAGE, 2 DRUMS, 2 DISKS, INPUT AND OUTPUT TAPES
12. PROGRAMMING LANGUAGE USED - FORTRAN II, EXCEPT FOR THE INPUT ROUTINES, DECIN AND INDEX.
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN II MONITOR WITH INPUT TAPE = 10, AND OUTPUT TAPE = 9.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - TO ADAPT THE CODE TO OTHER MACHINES THE MAJOR CONCERN IS LIKELY TO BE THE INTERMEDIATE (DISK AND DRUM) STORAGE. ALL OPERATIONS ON INTERMEDIATE STORAGE ARE INCLUDED IN SUBROUTINES TAPR AND TAPH.

15. NAME AND ESTABLISHMENT OF AUTHORS -

WILLIAM H. HANNUM AND B. M. CARMICHAEL
LOS ALAMOS SCIENTIFIC LABORATORY
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO 87544

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (4774 CARDS)
SAMPLE PROBLEM (76 CARDS)
REFERENCE REPORT

17. CATEGORY - L

KEYWORDS - 2-DIMENSIONAL, REACTORS, DESIGN, INPUT DATA PREPARATION

REACTOR CODE ABSTRACT 235

10/67

1. NAME OR DESIGNATION OF PROGRAM - GAMMA-P (NMP468)
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - CROSS SECTIONS FOR THE PRODUCTION OF GAMMA RAYS BY NEUTRON RADIATIVE CAPTURE, BY NEUTRON INELASTIC SCATTERING, AND BY NEUTRON-INDUCED FISSIONING ARE COMPUTED AS A FUNCTION OF NEUTRON LETHARGY GROUPS AND PHOTON ENERGY GROUPS.
4. METHOD OF SOLUTION - SEPARATION OF VARIABLES IS ASSUMED SO THAT THE CROSS SECTION FOR THE PRODUCTION OF GAMMA RAYS IN A GAMMA ENERGY GROUP BY RADIATIVE CAPTURE OF NEUTRONS IN A LETHARGY GROUP EQUALS THE CROSS SECTION FOR RADIATIVE CAPTURE OF NEUTRONS IN THAT LETHARGY GROUP MULTIPLIED BY THE GAMMA SPECTRUM RESULTING FROM NEUTRON RADIATIVE CAPTURE. SIMILAR ASSUMPTIONS ARE MADE FOR OTHER PRODUCTION REACTIONS. THE GAMMA ENERGY SPECTRUM FROM THERMAL NEUTRON CAPTURE IS NORMALIZED TO THE BINDING ENERGY OF THE NEUTRON. ALL UNMEASURED GAMMA ENERGY IS ASSUMED TO BE RELEASED IN THE LOWEST ENERGY GROUP. IT IS ASSUMED THAT THE GAMMA ENERGY FROM NEUTRON RADIATIVE CAPTURE EQUALS THE NEUTRON BINDING ENERGY PLUS KINETIC ENERGY. CORRECTIONS FOR INTERNAL CONVERSION ARE POSSIBLE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM NUMBER OF NEUTRON LETHARGY GROUPS = 30
 - MAXIMUM NUMBER OF PHOTON ENERGY GROUPS = 15
 - MAXIMUM NUMBER OF DISCRETE PHOTON ENERGY POINTS USED IN DESCRIBING A SPECTRUM = 100
 - MAXIMUM NUMBER OF INELASTIC SCATTERING CROSS SECTIONS = 10
6. TYPICAL RUNNING TIME - TWO SIMPLE CASES TOOK ABOUT 30 SECONDS EACH ON AN IBM7094 COMPUTER.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7094 VERSION SUBMITTED MARCH 1966.
10. REFERENCES - M. S. FERRY, PRODUCTION CROSS SECTIONS FOR GAMMA RAYS (PROGRAM GAMMA-P), GE-ANPD, XDC 60-11-138, AUGUST 17, 1960.
W. E. EDWARDS, GAMMA RAY PRODUCTION CROSS SECTIONS, GE-NMPO, GEMP-278, APRIL 7, 1964.
W. E. EDWARDS, GAMMA RAY PRODUCTION CROSS SECTIONS (SUPPLEMENT NO. 1), GE-NMPO, GEMP-360, AUGUST 26, 1965.
C. S. ROBERTSON AND M. R. EDWARDS, OPERATING INSTRUCTIONS FOR THE FORTRAN-IV VERSION OF PROGRAM GAMMA-P (NMP468), GEMP-392, NOVEMBER 23, 1965.

11. MACHINE REQUIREMENTS - 32K IBM7094. LOGICAL TAPE 8 IS USED FOR PUNCHED DECIMAL OUTPUT.
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBSYS.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - GAMMA-P SHOULD COMPILE ON ANY SYSTEM HAVING NAMELIST AND THE FORMAT GENERATOR FEATURE.
15. NAME AND ESTABLISHMENT OF AUTHORS -
M. R. EDWARDS, W. E. EDWARDS AND
C. S. ROBERTSON, JR.
GENERAL ELECTRIC COMPANY
NUCLEAR MATERIALS AND PROPULSION OPERATION
EVENDALE, OHIO
16. MATERIAL AVAILABLE -
SOURCE DECK (7094 - 401 CARDS)
SAMPLE PROBLEM (7094 - 20 CARDS)
REFERENCE REPORTS
17. CATEGORY - B
KEYWORDS - GAMMA RADIATION, CROSS SECTIONS, CAPTURE, INELASTIC SCATTERING, FISSION, NMP468 CODES

REACTOR CODE ABSTRACT 236

10/67

1. NAME OR DESIGNATION OF PROGRAM - DFSR
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - DATA FILE SERVICE ROUTINES (DFSR) ARE USED TO STORE, DISTRIBUTE, AND CHECK THE DATA ON THE EVALUATED NUCLEAR DATA FILE (ENDF). THERE ARE 6 ROUTINES -
 - DFSR1 - STORES DATA ON MASTER LIBRARY TAPES.
 - DFSR2 - PROCESSES REQUESTS FOR DATA BY FINDING THE APPROPRIATE DATA ON THE MASTER TAPES AND COPYING THEM ONTO THE REQUESTORS TAPE.
 - DFSR3 - CORRECTS DATA ON THE MASTER TAPES.
 - DFSR4 - COPIES/PRINTS/PUNCHES SELECTED DATA FROM THE MASTER TAPES.
 - DFSR5 - PRINTS LIST OF DATA RECENTLY ADDED TO MASTER TAPES AND PREPARES A CROSS-REFERENCE LIST OF ALL DATA ON THE MASTER TAPES.
 - DFSR6 - MAKES COPIES AND CHECKS THE MASTER TAPES.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - MAXIMUM OF FOUR MASTER LIBRARY TAPES IS ASSUMED.
 - MAXIMUM OF 2 REQUESTERS, EACH OF WHOM MAY HAVE UP TO 2000 REQUESTS FOR DFSR2, THE LIBRARY SEARCH AND TABULATION PROGRAM.
 - MAXIMUM OF 4000 DATA RECORDS ON MASTER TAPES FOR SORTING IN DFSR5 PROGRAM.
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7090 VERSION SUBMITTED MARCH 1966.
10. REFERENCE - H. C. HONECK AND J. FELBERBAUM, DESCRIPTION OF THE ENDF SERVICE ROUTINES, BNL-966, DECEMBER 1965.
11. MACHINE REQUIREMENTS - 32K WITH MINIMUM OF 7 TAPE UNITS (INCLUDING THOSE RESERVED FOR SYSTEMS USE)
12. PROGRAMMING LANGUAGES USED - FORTRAN II. A SHORT SUBROUTINE FOR BIT MANIPULATION IS WRITTEN IN FAP.
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN II MONITOR.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
ONE SUBROUTINE USES THE NON-STANDARD FORTRAN VERB UNLOAD.
15. NAME AND ESTABLISHMENT OF AUTHORS -
JOAN FELBERBAUM
BROOKHAVEN NATIONAL LABORATORY
UPTON, LONG ISLAND, NEW YORK 11973

HENRY C. HONECK
U. S. ATOMIC ENERGY COMMISSION
DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY
WASHINGTON, D. C.
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (6 FILES)
DFSR-1 SOURCE DECK AND SAMPLE PROBLEMS (953 CARDS)
DFSR-2 SOURCE DECK AND SAMPLE PROBLEM (431 CARDS)
DFSR-3 SOURCE DECK AND SAMPLE PROBLEM (612 CARDS)
DFSR-4 SOURCE DECK AND SAMPLE PROBLEM (392 CARDS)
DFSR-5 SOURCE DECK AND SAMPLE PROBLEM (525 CARDS)
DFSR-6 SOURCE DECK AND SAMPLE PROBLEM (386 CARDS)
REFERENCE REPORT
17. CATEGORY - M
KEYWORDS - ENDF LIBRARIES, CROSS SECTIONS, PREPARATION, MAINTENANCE, RETRIEVAL, DATA PROCESSING

REACTOR CODE ABSTRACT 237

10/67

1. NAME OR DESIGNATION OF PROGRAM - BOUNCE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE BOUNCE CODE DETERMINES THE ONE-GROUP THERMAL NEUTRON FLUX DISTRIBUTION WITHIN THE PIN BUNDLE OF A MULTIPLE-PIN FUEL ELEMENT. ALL SCATTERING WITHIN THE PINS IS CONSIDERED TO BE ISOTROPIC. ELEMENTS WITH 6, 7, 12, 13, 18, AND 19 FUEL PINS, WHERE EACH PIN IS COMPOSED OF A CENTRAL FUEL PELLET SURROUNDED BY A CLADDING MATERIAL, MAY BE TREATED. THE COOLANT REGION AROUND THE PINS IS ASSUMED TO CONTAIN A VOID.
4. METHOD OF SOLUTION - THE METHOD OF SUCCESSIVE GENERATIONS IS USED. THE FLUX OF UNSCATTERED NEUTRONS AT ANY POINT IS DETERMINED BY SOLVING THE EXACT TRANSPORT EQUATION AND INTEGRATING OVER THE SPECIFIED SOURCE OF THESE NEUTRONS. THIS FLUX VALUE IS USED TO DEVELOP THE SPATIAL SOURCE DISTRIBUTION OF ONCE-SCATTERED NEUTRONS. THE SOURCE DISTRIBUTION SO DEVELOPED IS USED TO CALCULATE THE FLUX OF ONCE-SCATTERED NEUTRONS, ETC. THE HIGHER GENERATION FLUXES BECOME SMALLER AND REACH THE POINT WHERE THEY MAY BE DISREGARDED. THE TOTAL NEUTRON FLUX IS THUS DERIVED AS THE SUM OF THESE VARIOUS FLUX VALUES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE GEOMETRY IS RESTRICTED TO A FIXED GENERAL PATTERN OF A SINGLE CENTRAL FUEL PIN LOCATED IN THE EXACT CENTER OF THE ELEMENT SURROUNDED BY A RING OF SIX FUEL PINS, WHICH IN TURN, ARE SURROUNDED BY A RING OF TWELVE FUEL PINS DISPLACED RADially FROM THE 6-PIN RING BY 15 DEGREES. IT IS POSSIBLE TO NEGLECT THE INNER 6-PIN RING, THE OUTER 12-PIN RING, OR THE CENTRAL PIN. ALL PINS WITHIN A RING ARE CONSIDERED TO HAVE THE SAME SIZE AND PROPERTIES.
6. TYPICAL RUNNING TIME - FIVE MINUTES FOR 7-PIN ELEMENT, TEN MINUTES FOR 19-PIN ELEMENT.
7. UNUSUAL FEATURES OF THE PROGRAM - THE PROPERTIES OF AN EQUIVALENT SOLID ROD, HAVING THE SAME ABSORPTION AS THE PIN BUNDLE, ARE DETERMINED. THE SUMMARY PRINTOUT INCLUDES THE REACTION RATES IN THE VARIOUS MATERIALS OF THE PIN BUNDLE.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7090 VERSION SUBMITTED MARCH 1966.
10. REFERENCE - T. P. WILCOX, BOUNCE, AN IBM7090 CODE TO CALCULATE FLUX DISTRIBUTIONS WITHIN MULTIPLE-PIN FUEL ELEMENTS BY THE METHOD OF SUCCESSIVE GENERATIONS, AGN-TM-411, NOVEMBER 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY WITH 4 TAPE UNITS

12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD IBM FORTRAN II MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
T. P. WILCOX
AEROJET-GENERAL NUCLEONICS
P. O. BOX 77
SAN RAMON, CALIFORNIA 94583
16. MATERIAL AVAILABLE -
SOURCE DECK (1892 CARDS)
SAMPLE PROBLEM (9 CARDS)
REFERENCE REPORT
17. CATEGORY - B
KEYWORDS - FUEL ELEMENTS, 1-GROUP, FLUX DISTRIBUTION, THERMAL
NEUTRONS, CELL CALCULATION, ISOTROPIC SCATTERING

REACTOR CODE ABSTRACT 238

1C/67

1. NAME OR DESIGNATION OF PROGRAM - EXT/XO
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - GIVEN A SET OF BREIT-WIGNER RESONANCE PARAMETERS (ZERO TEMPERATURE) EXT CALCULATES THE EFFECTIVE DOPPLER-BROADENED CROSS SECTIONS FOR ANY TEMPERATURE. THE EFFECTIVE CROSS SECTION WHEN MULTIPLIED BY THE TARGET DENSITY AND THE NEUTRON VELOCITY (LAB) GIVES THE REACTION RATE PER INCIDENT NEUTRON. A MAXWELLIAN VELOCITY DISTRIBUTION IS ASSUMED FOR THE TARGET NUCLEI. THE ANALYSIS IS CARRIED OUT FOR SUFFICIENTLY LOW ENERGIES SO THAT ONLY ZERO NEUTRON ANGULAR MOMENTA ($l = 0$) INTERACTIONS ARE IMPORTANT. INTERFERENCE BETWEEN LEVELS IS NEGLECTED, HOWEVER, INTERFERENCE BETWEEN RESONANCE SCATTERING AND POTENTIAL SCATTERING IS INCLUDED. THERE ARE PROVISIONS FOR ADDING A CORRECTION CROSS SECTION OF THE FORM $1.0/\sqrt{E}$ FOR LEVELS NOT EXPLICITLY CONSIDERED. ALSO THE CROSS SECTION IN THE WINGS OF A NEGATIVE ENERGY RESONANCE, $CONSTANT/(\sqrt{E} \cdot (E - E_0)^2)$ MAY BE ADDED.
4. METHOD OF SOLUTION - THE REQUIRED INTEGRATIONS ARE CARRIED OUT USING SIMPSONS RULE. THE SIZE OF THE INCREMENTS DEPENDS ON THE PARTICULAR RESONANCE WIDTH RELATIVE TO THE BROADENING EFFECTS DUE TO THE TARGET TEMPERATURE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE FOLLOWING LIMITS MAY NOT BE EXCEEDED -
 - 100 RESONANCES
 - 10 NEGATIVE RESONANCES
 - 10 TEMPERATURES
 - 200 ENERGY POINTS AT WHICH CROSS SECTIONS ARE CALCULATED
6. TYPICAL RUNNING TIME - .033 SECOND PER TEMPERATURE PER RESONANCE PER ENERGY POINT DEPENDING ON THE INTEGRATION CONSTANTS USED IN ASSOCIATION WITH THE GAUSSIAN. USUAL TIME FOR ONE TEMPERATURE, 16 RESONANCES, AND 120 ENERGY POINTS IS ONE MINUTE.
7. UNUSUAL FEATURES OF THE PROGRAM - THE INPUT RESONANCE PARAMETER CARDS USED BY EXT ARE ALSO IN THE PROPER FORMAT FOR USE IN UPDATING THE GAM LIBRARY.
8. RELATED AND AUXILIARY PROGRAMS -
 - XO - GIVEN A SET OF RESONANCE PARAMETERS, ASSUMING THE TARGET NUCLEI TO BE STATIONARY (ZERO TEMPERATURE) AND THE CROSS SECTION FOR EACH RESONANCE GIVEN BY THE SINGLE LEVEL BREIT-WIGNER FORMULA CALCULATES A SET OF CROSS SECTIONS AS THE SUM OF CONTRIBUTIONS FROM THE RESONANCES,

8. RELATED AND AUXILIARY PROGRAMS (CONTINUED)
CPS - GRAPHICAL REPRESENTATION OF COMPARISON OF CALCULATED (EXT) AND EXPERIMENTAL CROSS SECTIONS BY MEANS OF THE SC-4020 RECORDER,
GDTM - UPDATES NEUTRON CROSS SECTION LIBRARY,
GAM - USES THE UPDATED LIBRARY TAPE TO DETERMINE SLOWING DOWN SPECTRUM (ACC ABSTRACT 33).
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7094 VERSION SUBMITTED MARCH 1966.
10. REFERENCE - G. GIBSON AND M. MELNICK, XO AND EXT, IBM7094 PROGRAMS FOR COMPUTING - (A) THE RESONANCE CROSS SECTIONS FOR A ZERO TEMPERATURE (XO), (B) THE MAXWELLIAN DOPPLER BROADENED BREIT-WIGNER RESONANCES (EXT), WANL-TME-1132, MARCH 1965.
11. MACHINE REQUIREMENTS - 32K IBM7094
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM7094 FORTRAN II MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
G. GIBSON AND M. MELNICK
WESTINGHOUSE ASTRONUCLEAR LABORATORY
REACTOR PHYSICS AND MATHEMATICS
P. O. BOX 10864
PITTSBURGH, PENNSYLVANIA 15236
16. MATERIAL AVAILABLE -
SOURCE DECK (752 CARDS)
SAMPLE PROBLEM (63 CARDS)
REFERENCE REPORT
17. CATEGORY - A
KEYWORDS - CROSS SECTIONS, DOPPLER BROADENING, MAXWELL DISTRIBUTION, BREIT-WIGNER FORMULA, RESONANCE PARAMETERS, XO CODES

REACTOR CODE ABSTRACT 239

10/67

1. NAME OR DESIGNATION OF PROGRAM - CPS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - CPS PROVIDES A GRAPHICAL MEANS OF COMPARING EXPERIMENTAL CROSS SECTION VALUES OBTAINED FROM THE SCISRS LIBRARY TAPE WITH AN OPTION TO INCLUDE READING IN NEW EXPERIMENTAL OR CALCULATED VALUES.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - (A) FOUR SETS OF EXPERIMENTAL DATA PER TYPE OF CROSS SECTION CAN BE PLOTTED, THREE FROM TAPES AND ONE FROM CARDS.
 - (B) THERE ARE TWO TYPES OF PLOTS - LINEAR AND SEMI-LOG, WITH THE CROSS SECTION ON THE LOG SCALE.
6. TYPICAL RUNNING TIME - THE TIME INVOLVED IN WRITING ONE INTERMEDIATE TAPE OF 278 POINTS TO PRODUCE ONE FRAME OF 60 PLOTTED POINTS IS 1.98 MINUTES. TO PRODUCE THE SAME FRAME, BUT WITH THE INTERMEDIATE TAPE MOUNTED, REQUIRES 0.06 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - THE INTERMEDIATE TAPE CONSISTING OF DATA PER TYPE OF CROSS SECTION PER EXPERIMENTALIST IS WRITTEN BY A SEPARATE CHAIN WHICH IS CALLED UPON WHEN AN INPUT INDICATOR IS SET. THIS ALLOWS RE-USE OF THE INTERMEDIATE TAPE WHEN EXTENSIVE COMPARISON WORK IS DONE AGAINST A SET OF EXPERIMENTAL CURVES, SAVING COMPUTER TIME. ANOTHER FEATURE IS THAT THE USER SELECTS THE TAPE DRIVES UPON WHICH TO MOUNT THE INITIAL RETRIEVAL TAPE AND UPON WHICH TO MOUNT OR WRITE THE INTERMEDIATE TAPES. THIS IS USEFUL WHEN STACKING PROBLEMS DUE TO THE VARIABILITY OF THE NUMBER OF INTERMEDIATE TAPES.
8. RELATED AND AUXILIARY PROGRAMS -
 - RETREV - RETRIEVES REQUESTED DATA FROM THE SCISRS LIBRARY TAPE AND WRITES THIS INFORMATION ON AN INITIAL RETRIEVAL TAPE USED BY CPS.
 - EXT - CALCULATES DOPPLER-BROADENED CROSS SECTION VALUES FROM RESONANCE PARAMETERS (ACC ABSTRACT 2381).
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7094 VERSION SUBMITTED MARCH 1966.
10. REFERENCE - M. M. MELNICK, CURVE PLOT FOR SCISRS, WANL-TME-1317, NOVEMBER 1965.
11. MACHINE REQUIREMENTS - 32K IBM7094, LIBRARY TAPES, ON-LINE PRINTER AND ACCESS TO SC-4020 DISPLAY
12. PROGRAMMING LANGUAGE USED - FORTRAN II

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD FORTRAN II MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
BINARY DECK OF THE SC-4020 ROUTINES IS INCLUDED. SOURCE DECK MAY
BE OBTAINED BY WRITING TO -
QUENTIN CHIN
STROMBERG-CARLSON CORPORATION
P. O. BOX 2449
SAN DIEGO, CALIFORNIA 92112
IN ADDITION, A FAP DECK OF TEST36 IS INCLUDED. CPS IS A CHAIN JOB
ON TAPE NUMBER 2. THE SCISRS LIBRARY TAPE AND RETREV PROGRAM MAY
BE OBTAINED BY WRITING TO -
J. M. FRIEDMAN
APPLIED MATHEMATICS DEPARTMENT
BROOKHAVEN NATIONAL LABORATORY
UPTON, LONG ISLAND, NEW YORK 11973
15. NAME AND ESTABLISHMENT OF AUTHOR -
M. M. MELNICK
WESTINGHOUSE ASTRONUCLEAR LABORATORY
REACTOR PHYSICS AND MATHEMATICS
P. O. BOX 10864
PITTSBURGH, PENNSYLVANIA 15236
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK INCLUDING SC-4020 BINARY SUBROUTINE DECK AND
TEST36 FAP DECK (1149 CARDS)
INITIAL RETRIEVAL TAPE FOR SAMPLE PROBLEM (1545 CARDS)
REFERENCE REPORT
17. CATEGORY - N
KEYWORDS - CROSS SECTIONS, GRAPHS, SCISRS LIBRARIES, RETRIEVAL,
DATA PROCESSING

REACTOR CODE ABSTRACT 240

10/67

1. NAME OR DESIGNATION OF PROGRAM - ASSAULT
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - MULTIGROUP, TWO-DIMENSIONAL REACTOR DEPLETION. GIVEN NUCLIDE CONCENTRATIONS AND MICROSCOPIC CROSS SECTIONS, THE STEADY-STATE MULTIREGION, MULTIGROUP DIFFUSION EQUATIONS ARE SOLVED IN ONE OR TWO DIMENSIONS OVER A FINITE-DIFFERENCE SYSTEM OF MESH POINTS. THE CALCULATED NEUTRON FLUXES ARE THEN USED TO DETERMINE NUCLIDE CONCENTRATIONS AFTER A SPECIFIED PERIOD OF EXPOSURE. THESE CALCULATIONS ARE REPEATED FOR A SPECIFIED NUMBER OF TIME-STEPS.
4. METHOD OF SOLUTION - THE CODE EXTERMINATOR (ACC ABSTRACT 156) WAS ADAPTED FOR USE IN ASSAULT TO DO THE FLUX-EIGENVALUE CALCULATION. A GENERAL EXPLICIT CALCULATION OF NUCLIDE CONCENTRATIONS WITH FLUX EXPOSURE IS THEN USED TO SOLVE THE NUCLIDE CHAIN EQUATIONS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - FOR A PROBLEM WITH I ROWS AND J COLUMNS IN THE DIFFERENCE MESH, K ENERGY GROUPS, M MATERIALS OF DIFFERENT COMPOSITION, N NUCLIDES, X NUCLIDES WITH CROSS SECTIONS (EXCLUDING PURE DECAY NUCLIDES WHICH ARE NOT INCLUDED ON THE CROSS SECTION LIBRARY TAPES), D CYCLES DELAY IN FUEL RECYCLE, AND U FUEL MAKEUP REGIONS, THE RESTRICTIONS ARE -

SYMBOL	GREATER THAN OR EQUAL TO	LESS THAN OR EQUAL TO
I	3	250
J	3	250
K	1	50
M	1	400
N	1	200
I*J	9	20000
I*K	3	2000
J*(5+K)	18	2000
K*M	1	800
K(K+M)	1	10000
N(M+D+U)+2X*K	1	14000

6. TYPICAL RUNNING TIME - A REPRESENTATIVE ONE-DIMENSIONAL SINGLE-CORE DEPLETION PROBLEM REQUIRES ABOUT ONE HOUR OF MACHINE TIME, AND A TWO-DIMENSIONAL PROBLEM REQUIRES SIX HOURS OR MORE. AN 8-GROUP PROBLEM WITH 648 MESH POINTS REQUIRED 7.2 HOURS FOR 20 TIME-STEPS.
7. UNUSUAL FEATURES OF THE PROBLEM -
 - (A) XY, RZ, OR R-THETA GEOMETRY MAY BE CONSIDERED.
 - (B) SCATTERING FROM ANY GROUP TO ANY OTHER GROUP IS ALLOWED.

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)

- (C) CRITICALITY MAY BE SATISFIED BY DIRECT SEARCH ON A GROUP- AND REGION-DEPENDENT POISON (WHICH NORMALLY REQUIRES NO EXTRA MACHINE TIME) OR BY A DOUBLE ITERATION SEARCH ON FUEL OR MODERATOR MIXTURE.
- (D) NUCLIDE CHAINS ARE SPECIFIED BY THE USER. THERE IS PROVISION TO CONSIDER INTERLOCKED CHAINS, PARTIAL-CAPTURE CHAIN ROUTES, AND HIGH-ENERGY (N,2N) PRODUCT CHAIN ROUTES.
- (E) NUCLIDE CONCENTRATIONS MAY BE CHANGED, MATERIAL ADDED OR REMOVED, AND/OR MATERIAL INTERCHANGED WITHIN THE REACTOR CORE AT ANY TIME. PROVISION IS MADE FOR RECYCLE, TAKING INTO ACCOUNT SEVERAL CYCLES, AND HOLD UP OF MATERIAL OUTSIDE THE REACTOR MAY BE CONSIDERED.
- (F) THE CALCULATION OF A REACTOR MAY BE CONTROLLED MANUALLY AT THE COMPUTER CONSOLE, IF DESIRED, THROUGH THE USE OF SENSE SWITCHES, THE ON-LINE PRINTER, AND THE INPUT TAPE. FOR EXAMPLE, BY FOLLOWING K-EFFECTIVE FOR EACH TIME-STEP, CRITICALITY COULD BE MAINTAINED BY MATERIAL INTERCHANGES (CONTROL OF THE INPUT DATA TAPE) AT APPROPRIATE TIME-STEPS.
- (G) FUEL-CYCLE COSTS CAN BE CALCULATED.

8. RELATED AND AUXILIARY PROGRAMS - ASSAULT IS ESSENTIALLY A COUPLING OF THE EXTERMINATOR MULTIGROUP DIFFUSION PROGRAM (ACC ABSTRACT 156) AND THE DEPLETION PORTION OF THE TONG CODE WHICH SOLVES THE GENERAL NUCLIDE CHAIN EQUATIONS. THE MICROSCOPIC CROSS SECTION TAPE THAT ASSAULT USES IS NORMALLY WRITTEN BY THE TONG PROGRAM.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7090 VERSION SUBMITTED MARCH 1966.

10. REFERENCES - D. R. VONDY, T. B. FOWLER AND M. L. TOBIAS, REACTOR DEPLETION CODE ASSAULT (TWO-DIMENSIONAL, MULTI-NEUTRON-GROUP), ORNL-TM-1302, MARCH 1966.

T. B. FOWLER, M. L. TOBIAS AND D. R. VONDY, EXTERMINATOR, A MULTIGROUP CODE FOR SOLVING NEUTRON DIFFUSION EQUATIONS IN ONE AND TWO DIMENSIONS, ORNL-TM-842, FEBRUARY 1965.

D. R. VONDY AND T. B. FOWLER, COMPUTER CODE TONG FOR ZERO-DIMENSIONAL REACTOR DEPLETION CALCULATIONS, ORNL-TM REPORT TO BE PUBLISHED.

11. MACHINE REQUIREMENTS - 32K IBM7090, ON-LINE PRINTER, AND A MINIMUM OF SEVEN TAPE UNITS ON CHANNEL A (INCLUDING SYSTEM TAPE, INPUT TAPE, AND OUTPUT TAPE), AND SEVEN TAPE UNITS ON CHANNEL B

12. PROGRAMMING LANGUAGES USED - FORTRAN II, WITH FAP USED FOR TAPE I/O ROUTINES.

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13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
ASSAULT WAS PROGRAMMED TO RUN UNDER CONTROL OF THE FORTRAN-11,
VERSION-2 MONITOR SYSTEM DESIGNATED IBM-709FD-062.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
THIS CODE CONSISTS OF 12 CHAIN LINKS, CONTAINING A TOTAL OF
8000 SOURCE STATEMENTS.
15. NAME AND ESTABLISHMENT OF AUTHORS -
D. R. VONDY, T. B. FOWLER AND M. L. TOBIAS
OAK RIDGE NATIONAL LABORATORY
P. O. BOX X
OAK RIDGE, TENNESSEE 37831
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (11545 CARDS)
SAMPLE PROBLEM (51 CARDS)
REFERENCE REPORTS, ORNL-TM-1302 AND ORNL-TM-842
17. CATEGORY - 0
KEYWORDS - DEPLETION, DIFFUSION EQUATIONS, 1-DIMENSIONAL, 2-
DIMENSIONAL, MULTIGROUP, PRODUCTION, DECAY, CRITI-
CALITY, POISON, SEARCHES

1. NAME OR DESIGNATION OF PROGRAM - HFN
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090, UNIVAC 1107
3. NATURE OF PHYSICAL PROBLEM SOLVED - HFN SOLVES THE HOMOGENEOUS OR INHOMOGENEOUS ONE-DIMENSIONAL MULTIGROUP DIFFUSION EQUATION FOR ITS LOWEST EIGENVALUE AND THE CORRESPONDING DIRECT AND/OR ADJOINT EIGENVECTORS. INHOMOGENEOUS BOUNDARY CONDITIONS AND A FLEXIBLE SCATTER-TRANSFER MATRIX STRUCTURE ARE INCLUDED. OPTIONAL CALCULATIONS INCLUDE CRITICALITY SEARCHES, DETECTOR ACTIVATION TRAVERSES, AND INTEGRALS FOR PERTURBATION THEORY ANALYSIS.
4. METHOD OF SOLUTION - ENERGY-SPACE SEPARABILITY OF THE FLUX IS ASSUMED AND A FINITE DIFFERENCE APPROXIMATION EMPLOYED. THE RESULTING FLUX EQUATIONS ARE SOLVED BY A GAUSSIAN FORWARD ELIMINATION, BACKWARD SUBSTITUTION METHOD. FOR MORE DETAILS, SEE REFERENCE 1.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

NUMBER OF	GREATER THAN OR EQUAL TO	LESS THAN OR EQUAL TO
ENERGY GROUPS	2	20
REGIONS	1	50
MATERIALS	1	100
GROUP PARAMETERS		3500
GROUPS*MESH POINTS		2100

6. TYPICAL RUNNING TIME - BECAUSE OF FLEXIBILITY, THE TIME REQUIRED VARIES GREATLY. IN A SPECIFIC CASE OF 10 GROUPS, 100 MESH POINTS, 3 REGIONS, DIRECT FLUX ONLY, NO UPSCATTERING, APPROXIMATELY 10-20 SECONDS WERE USED.
7. UNUSUAL FEATURES OF THE PROGRAM - THE OPTIONAL CALCULATIONS INCLUDED SUCH AS CRITICALITY SEARCH ON ONE VARIABLE, FISSION DENSITIES, POWER DENSITIES, AND FLUX GRADIENTS, REGIONWISE AVERAGE FLUXES, POWER, AND FISSION DENSITIES, LEAKAGE CROSS SECTIONS, PERTURBATION INTEGRALS, POINTWISE AND GROUPWISE DIRECT-ADJOINT FLUX-GRADIENT AND FLUX PRODUCTS, AND DETECTOR ACTIVATION TRAVERSES. HFN DOES ITS OWN LIBRARY TAPE UPDATING, AND INCLUDES SURFACE, POINTWISE, OR REGIONWISE SOURCE SPECIFICATION OPTIONS.
8. RELATED AND AUXILIARY PROGRAMS - HFN IS AN EXTENSIVE MODIFICATION OF GE-ANPD PROGRAM FN, AND USES THE LISTIV, GENERALIZED INPUT ROUTINE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
UNIVAC1107 VERSION SUBMITTED MARCH 1966.

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10. REFERENCES - P. G. FISCHER, MULTIGROUP, MULTIREGION, ONE SPACE DIMENSION NEUTRON DIFFUSION THEORY CALCULATION - PROGRAM FN, XDC-60-3-68.
J. R. LILLEY, COMPUTER CODE HFN - MULTIGROUP, MULTIREGION, NEUTRON DIFFUSION THEORY IN ONE SPACE DIMENSION, HW-71545, NOVEMBER 17, 1961.
D. D. MATSUMOTO, LISTIV - A FORTRAN IV GENERALIZED INPUT ROUTINE, BNWL-41, MARCH 1965.
11. MACHINE REQUIREMENTS - 32K IBM7090 WITH 4 TAPE UNITS (INCLUDING SYSTEM TAPE, INPUT, AND OUTPUT), ON-LINE PRINTER AND CLOCK. 64K UNIVAC1107, 786,432 WORD DRUM (EXCLUSIVE OF SYSTEM REQUIREMENTS), WITH 1 TAPE UNIT, ON-LINE PRINTER, CARD READER AND CLOCK.
12. PROGRAMMING LANGUAGES USED - IBM7090 FORTRAN II (95 PERCENT)
FAP (5 PERCENT)
UNIVAC 1107 FORTRAN IV (99.9 PERCENT)
SLEUTH-II (0.1 PERCENT)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM7090 - FORTRAN II MONITOR. UNIVAC 1107 - CSC EXEC II, PACKAGE B.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
J. R. LILLEY (CODE)
D. R. MARR (ABSTRACT)
BATTELLE-NORTHWEST
P. O. BOX 99
RICHLAND, WASHINGTON 99352
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (4045 CARDS)
SOURCE DECK (1107)
SAMPLE PROBLEM (1107)
REFERENCE REPORTS, BNWL-41 AND HW-71545
17. CATEGORY - C
KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, MULTIGROUP, CRITICALITY SEARCHES, SLABS, CYLINDERS, SPHERES, LISTIV CODES

1. NAME OR DESIGNATION OF PROGRAM - RATH MESHER/RATH WANTON
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094,30
3. NATURE OF PHYSICAL PROBLEM SOLVED - THESE CODES SOLVE THE TWO- AND THREE-DIMENSIONAL HEAT CONDUCTION PROBLEM IN GENERAL GEOMETRIES. TIME, TEMPERATURE, AND POSITION-DEPENDENT PHYSICAL PROPERTIES CAN BE USED.
4. METHOD OF SOLUTION - THE WANTON HEAT CONDUCTION EQUATIONS ARE SOLVED BY THE EXTRAPOLATED LIEBMAN METHOD AND THE EXTRAPOLATION PARAMETER IS COMPUTED BY THE METHOD OF B. A. CARRE (COMPUTER JOURNAL, VOLUME 4, NUMBER 1, APRIL 1961). AN IMPLICIT DIFFERENCING SCHEME ALLOWS ANY SIZE OF TIME-STEP IN A TRANSIENT PROBLEM. THE PROGRAM ALLOWS THE FOLLOWING BOUNDARY CONDITIONS - CONVECTION, CONTACT COEFFICIENT BETWEEN TWO SOLID REGIONS, BOUNDARY FLUX, AND BOUNDARY RADIATION. THE COMPUTATIONAL MODEL ASSUMES THAT THE MATERIAL IS DIVIDED INTO CELLS INTERCONNECTED IN ANY ARBITRARY MANNER BY HEAT FLOW PATHS. BY MEANS OF THE MESHER ANY TWO-DIMENSIONAL FIGURE DESCRIBED IS AUTOMATICALLY DIVIDED INTO NODES (OR CELLS) AND THE DESCRIPTIVE DATA REQUIRED FOR EACH GENERATED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE RATH MESHER CAN MESH PROBLEMS COMPOSED OF STRAIGHT-LINE SEGMENTS AND CIRCULAR ARCS. THE RATH WANTON HEAT CONDUCTION CODE CAN RUN PROBLEMS WITH UP TO SEVEN REGIONS (SEPARATE MESHES) AND CONTAINING APPROXIMATELY 1000 TO 1200 MESH POINTS PER LAYER. THERE IS NO PROVISION FOR INTERNAL RADIATION.
6. TYPICAL RUNNING TIME - MESHER TIMES ARE GENERALLY LESS THAN FIVE MINUTES. THOSE FOR WANTON ARE MUCH HARDER TO ESTIMATE BUT THE CODE CONTAINS A DUMP AND RESTART FEATURE TO ALLOW RUNNING IN BURSTS.
7. UNUSUAL FEATURES OF THE PROGRAM - THE PROGRAMS ALLOW GENERAL TREATMENT OF BOTH GEOMETRIES, PHYSICAL PROPERTIES AND BOUNDARY CONDITIONS.
8. RELATED AND AUXILIARY PROGRAMS - CODES RELATED TO THIS SYSTEM ARE PLTMESH- WHICH PRODUCES A PICTURE OF THE MESH, AND SMPLOT- WHICH PRODUCES A TWO-DIMENSIONAL ISOTHERM PLOT FROM OUTPUT PUNCHED BY WANTON. BOTH OF THESE USE THE SC-4020.
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7094 VERSION SUBMITTED MARCH 1966.
IBM7030 VERSION SUBMITTED JULY 1967.
10. REFERENCES - R. F. THOMAS, JR., THE RATH MESHER, A 7090 PROGRAM FOR PREPARING INPUT DATA FOR HEAT CONDUCTION CODES, LAMS-2809, JANUARY 22, 1963.

10. REFERENCES (CONTINUED) -

R. F. THOMAS, JR., AND M. D. J. MACROBERTS, RATH
THERMAL ANALYSIS PROGRAMS, LA-3264-MS, MAY 5, 1965.

11. MACHINE REQUIREMENTS - 32K IBM7094. CHANNEL A WITH SIX TAPES, CARD READER, PUNCH, PRINTER AND A CLOCK. CHANNEL B WITH FIVE TAPES. CHANNEL C WITH A DRUM ON MODULE 2. NOTE, IF TAPE IS USED ON THREE-DIMENSIONAL PROBLEMS WHICH OVERFLOW MEMORY, THEN THE DRUM IS NOT NECESSARY.
12. PROGRAMMING LANGUAGE USED - BOTH CODES ARE WRITTEN IN FAP. SUBROUTINES SUPPLIED TO WANTON BY THE USER MAY BE WRITTEN IN FAP OR FORTRAN.
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - BOTH PROGRAMS USE THE VERSION 2 MONITOR FOR WANTON CANNOT LOAD ON ANY OTHER SYSTEM. BOTH THE LOS ALAMOS LOGICAL TAPE DEFINITION TABLE (LOUT) WHICH IS DIFFERENT FROM THE STANDARD IBM LOGICAL DEFINITION AND ABSOLUTE TAPE ADDRESSING ARE USED IN THE CODE. THIS MAY RESULT IN SOME DIFFICULTY. AT LAST TAPE 9 (A3) IS OUTPUT, 10 (A2) IS INPUT, AND TAPE 12 (B5) IS FOR OUTPUT ON FILM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
R. F. THOMAS JR. AND M. D. J. MACROBERTS
LOS ALAMOS SCIENTIFIC LABORATORY
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO 87544
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (RATH MESHER/RATH WANTON 7094-21804 CARDS, RATH
MESHER 7030-4052 CARDS)
SAMPLE PROBLEM (RATH MESHER/RATH WANTON 7094-198 CARDS)
REFERENCE REPORTS
17. CATEGORY - H
KEYWORDS - HEAT TRANSFER, 2-DIMENSIONAL, 3-DIMENSIONAL, SPACE-
TIME, TEMPERATURE, MESHER CODES, WANTON CODES

1. NAME OR DESIGNATION OF PROGRAM - AGN-SIGMA
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - AGN-SIGMA CALCULATES THE LEGENDRE COMPONENTS OF THE MULTIGROUP TRANSFER MATRICES $\Sigma_{l,g \rightarrow g+n}$ FOR FAST NEUTRONS. REACTIONS CONSIDERED ARE ELASTIC SCATTERING, INELASTIC SCATTERING (LEVEL EXCITATION AND THE EVAPORATION MODEL), AND THE FOLLOWING FIVE DECAY MODES FOR THE $(n,2n)$ REACTION -- $A(n,n_1)A^*(n_2)(A-1)^*$, 3- AND 4- BODY PHASE SPACE MODEL, EVAPORATION MODEL, AND THE CLUSTER MODEL, WHERE A^* IS THE RECOIL NUCLEUS. ALL NUCLEAR LEVELS INVOLVED IN THE TRANSITIONS ARE DISCRETE. THE CODE MAY ALSO BE USED TO CALCULATE GROUP-AVERAGED CROSS SECTIONS AS WELL AS TO MANIPULATE, E.G., ADD, MULTIPLY, ETC., THE OUTPUT MATRICES. THE NEUTRON SPECTRUM MAY BE A COMBINATION OF FISSION AND 1/E OR ARBITRARY INPUT DATA.
4. METHOD OF SOLUTION - ALL INTEGRATIONS ARE PERFORMED BY AN ITERATIVE SIMPSONS RULE. THE TRANSFER CROSS SECTIONS $\Sigma_{l,g \rightarrow g+n}$ FOR A GIVEN g , n , AND ALL l , ARE CALCULATED CONCURRENTLY BY SERIES-PARALLEL PASSING THROUGH THE INTEGRATION SCHEME. SUB-RANGES ON THE INTEGRATIONS ARE SPECIFIED BETWEEN ALL INPUT DATA POINTS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
THE CENTER-OF-MASS DIFFERENTIAL CROSS SECTION IS EXPRESSED BY A LEGENDRE EXPANSION UP THROUGH THE TENTH DEGREE.
MAXIMUM NUMBER OF GROUPS = 100
MAXIMUM NUMBER OF GROUPS DOWNSCATTER = 50
MAXIMUM l = 5 FOR TRANSFER MATRICES
6. TYPICAL RUNNING TIME - IT REQUIRED FOUR MINUTES TO CALCULATE THE p_1 ELASTIC SCATTERING MATRICES FOR 66 GROUPS, WITH 2 DOWNSCATTER GROUPS, AND CROSS SECTION DATA AT 66 ENERGY POINTS USING A p_6 EXPANSION OF THE DIFFERENTIAL CROSS SECTION.
7. UNUSUAL FEATURES OF THE PROGRAM - BOTH PRINTED AND PUNCHED OUTPUT ARE PROVIDED.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7094 VERSION SUBMITTED APRIL 1966.
10. REFERENCE - S. T. PERKINS, D. W. THOMPSON AND P. J. DUBOIS, USERS MANUAL FOR AGN-SIGMA, A CODE TO CALCULATE THE LEGENDRE COMPONENTS OF THE MULTIGROUP TRANSFER MATRICES AND THE GROUP CROSS SECTIONS, AN-1447, OCTOBER 1965.
11. MACHINE REQUIREMENTS - 32K IBM7090/94, WITH 4 TO 11 TAPE UNITS, DEPENDING UPON THE SPECIFIED VALUE OF l

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12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
STANDARD IBM FORTRAN II MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
ERROR DUMPS WITH APPROPRIATE COMMENTS OCCUR FOR THE COMMON
RECOGNIZABLE ERRORS. THE AGN INSTALLATION DUMP ROUTINE EMPTY IS
USED, AND A DRIVER PROGRAM IS REQUIRED TO CALL THE CHAIN TAPE
INFORMATION INTO CORE INITIALLY.
15. NAME AND ESTABLISHMENT OF AUTHORS -
S. T. PERKINS,* D. W. THOMPSON,* AND
P. J. DUBOIS*
AEROJET-GENERAL NUCLEONICS
P. O. BOX 77
SAN RAMON, CALIFORNIA 94583
* NOW AT LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK WITH DUMMY EMPTY ROUTINE (5752 CARDS)
SAMPLE PROBLEM INCLUDING DRIVER DECK (45 CARDS)
REFERENCE REPORT
17. CATEGORY - B
KEYWORDS - MULTIGROUP CROSS SECTIONS, ELASTIC SCATTERING, INELAS-
TIC SCATTERING, LEGENDRE COEFFICIENTS, AVERAGES

1. NAME OR DESIGNATION OF PROGRAM - CYCLOPS1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - CYCLOPS1 IS A PROGRAM FOR THE ANALYSIS OF THERMODYNAMIC SYSTEMS. IT IS A GENERAL PURPOSE PROGRAM THAT PERFORMS A HEAT AND MASS BALANCE FOR THERMODYNAMIC SYSTEMS COMPOSED OF PUMPS, TURBINES, SEPARATORS, HEAT EXCHANGERS, COMPRESSORS AND FLOW THROTTLING DEVICES. THESE COMPONENTS MAY BE CONNECTED IN ANY DESIRED WAY. THE THERMODYNAMIC FLUIDS THAT MAY BE USED ARE WATER, AIR, NITROGEN, AND PARA-HYDROGEN.
4. METHOD OF SOLUTION - ITERATIVE SOLUTION TO THE ALGEBRAIC EQUATIONS DESCRIBING THE THERMODYNAMICS OF THE SYSTEM.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - STEAM, AIR, NITROGEN, OR PARA-HYDROGEN CYCLE PUMPS LIMITED TO 24 STAGES. NO CYCLE MAY HAVE MORE THAN 100 STATIONS.
6. TYPICAL RUNNING TIME - THE RUNNING TIME IN SECONDS CAN BE ESTIMATED AS FOLLOWS -
$$\text{TIME (SEC)} = 15 + NT * 5 + NP * 2 + NS * 0.01$$

WHERE
NT = NUMBER OF TURBINES
NP = NUMBER OF PUMPS
NS = NUMBER OF STATIONS
7. UNUSUAL FEATURES OF THE PROGRAM -
 - (A) INPUT CONDITIONS CAN BE ENTERED AT ANY POINT IN THE SYSTEM.
 - (B) THERMODYNAMIC CONDITIONS CAN BE TRANSFERRED FROM ONE POINT TO ANY OTHER POINT.
 - (C) AN ITERATION ROUTINE CAN BE USED TO OBTAIN A DESIRED PARAMETER AT SOME POINT IN THE SYSTEM CALCULATION.
 - (D) AN ACCUMULATOR ROUTINE CAN BE USED EITHER TO SUM OR TO MOVE ONE PARAMETER FROM ONE POINT TO ANOTHER.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7094 VERSION SUBMITTED MAY 1966.
10. REFERENCE - L. R. BLUE, J. L. GRIMALDI, AND J. A. HESSLER, CYCLE OPTIMIZATION SYSTEM (CYCLOPS-1), AN IBM 7094 PROGRAM FOR HEAT AND MASS BALANCE OF THERMODYNAMIC SYSTEMS, NAA-SR-MEMO-9851, JULY 1964.
11. MACHINE REQUIREMENTS - IBM7094
12. PROGRAMMING LANGUAGE USED - FORTRAN II

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13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM FORTRAN II MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
J. A. HESSLER
MATHEMATICAL AND COMPUTING SCIENCES GROUP
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA 91304
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2931 CARDS)
SAMPLE PROBLEM (535 CARDS)
STEAM TABLES (156 CARDS)
REFERENCE REPORT
17. CATEGORY - I
KEYWORDS - THERMODYNAMICS, DESIGN, PUMPS, WATER, NITROGEN

1. NAME OR DESIGNATION OF PROGRAM - FLOW-MODEL
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - A MULTI-CHANNEL, TWO-DIMENSIONAL, TWO-PHASE FLOW MODEL, DESIGNED TO COMPUTE THE AXIAL AND RADIAL COOLANT DENSITY AND QUALITY PROFILES, THE AXIAL PRESSURE PROFILE AND THE WEIGHT FLOW DISTRIBUTION FOR AN OPEN MATRIX FLOW, BOILING WATER REACTOR.
4. METHOD OF SOLUTION - THE DISCONTINUOUS NODAL FLOW MODEL APPROXIMATION LEADS TO A SYSTEM OF SIMULTANEOUS NONLINEAR EQUATIONS WHICH ARE SOLVED BY ITERATION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
20 CHANNELS
100 AXIAL NODES
100 AXIAL Q POINTS
6. TYPICAL RUNNING TIME - ONE CASE WITH 3 CHANNELS AND 40 NODES REQUIRES ABOUT 20 SECONDS FOR BOTH PRINTED AND GRAPHICAL OUTPUT.
7. UNUSUAL FEATURES OF THE PROGRAM - THE PROGRAM CAN USE AN SC-4020 GRAPHICAL DISPLAY DEVICE FOR PLOTTING RESULTS.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED JULY 1966.
IBM7094 VERSION SUBMITTED MAY 1966.
10. REFERENCES - D. E. SCHRAMM AND R. F. BERLAND, A MULTI-CHANNEL TWO-DIMENSIONAL, TWO-PHASE FLOW MODEL AND IBM7090 CODE, NAA-SR-MEMO-9444, DECEMBER 31, 1963.
M. HOFFMAN AND W. A. RHOADES, AICRT3, A GENERAL CODE FOR DISPLAY OF DIGITAL DATA, NAA-SR-MEMO-9069, OCTOBER 1963.
11. MACHINE REQUIREMENTS - 32K IBM7094
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN MONITOR.

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14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
IF AN SC-4020 GRAPHICAL DISPLAY DEVICE IS AVAILABLE, THE DUMMY
SUBROUTINE AICRT3 SHOULD BE REPLACED BY THE FORTRAN II AICRT3 SUB-
ROUTINE AND THE NAA-SC-4020 SUBROUTINE PACKAGE WHICH ARE AVAILABLE
THROUGH -

UAIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA

15. NAME AND ESTABLISHMENT OF AUTHOR -
R. F. BERLAND
MATHEMATICAL AND COMPUTING SCIENCES GROUP
ATOMICS INTERNATIONAL
P. O. BOX 309
CANDGA PARK, CALIFORNIA 91304

16. MATERIAL AVAILABLE -
SOURCE DECK (366 CARDS)
SAMPLE PROBLEM (36 CARDS)
REFERENCE REPORTS

17. CATEGORY - H
KEYWORDS - 2-DIMENSIONAL, FLUID FLOW, COOLANTS DISTRIBUTIONS,
GRAPHS

1. NAME OR DESIGNATION OF PROGRAM - FLANGE1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - FLANGE1 OPERATES ON A TABULATED NEUTRON SCATTERING LAW, $S(\alpha, \beta)$, TO DEVELOP SEVERAL TYPES OF CROSS SECTION INFORMATION. THE VARIOUS CALCULATED CROSS SECTIONS NOW AVAILABLE ARE -
 - SIGMA (E-PRIME TO E, MU).
 - SIGMA (E-PRIME, MU).
 - SIGNAL (E-PRIME TO E).
 - SIGNAL (E-PRIME).
 - M2 (E-PRIME), SECOND ENERGY TRANSFER MOMENT.
 - X1 SIGMAS BAR, AVERAGE SLOWING DOWN POWER.
 - SIGNAL (MAXWELLIAN AVERAGED).
 - L REFERS TO THE LEGENDRE MOMENT. $L = 0, 1, 2, 3$ ARE AVAILABLE.
 - M2 (MAXWELLIAN AVERAGED).
 - A TAPE OF ANGULAR CROSS SECTIONS IS PREPARED TO BE USED AS INPUT TO THE MULTIPLE SCATTERING CODE MUSE.
4. METHOD OF SOLUTION - THE LOGARITHM OF THE SCATTERING LAW IS ASSUMED TO BE LINEAR IN BOTH ALPHA AND BETA FOR PURPOSES OF THE INTERPOLATION NEEDED TO OBTAIN CROSS SECTIONS FOR A GIVEN INITIAL AND FINAL ENERGY AND SCATTERING ANGLE IN TERMS OF THE CORRESPONDING (DIMENSIONLESS) ENERGY AND MOMENTUM TRANSFER, BETA AND ALPHA. THE BASIC CROSS SECTION PRODUCED IS THE DOUBLE-DIFFERENTIAL ANGULAR CROSS SECTION, SIGMA (E-PRIME TO E, MU). THE CODE HAS PROVISION FOR PERFORMING TRAPEZOIDAL INTEGRATIONS OVER FINAL ENERGY AND A CHOICE OF 15-POINT GAUSS QUADRATURE, SIMPSONS RULE, OR EXACT-ALPHA INTEGRATION OVER SCATTERING ANGLE. THE EXACT-ALPHA ANGULAR INTEGRATION IS AN ANALYTIC INTEGRATION OVER ALL ALPHA VALUES CONTAINED WITHIN AN ANGULAR INTERVAL, AGAIN ASSUMING THE LOGARITHM OF THE SCATTERING LAW TO BE LINEAR BETWEEN MESH POINTS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE SCATTERING LAW IS RESTRICTED TO 80 ALPHA VALUES AND 150 BETA VALUES. SCATTERING KERNELS ARE LIMITED TO A 101-POINT ENERGY MESH.
6. TYPICAL RUNNING TIME - 6 MINUTES IS REQUIRED TO GENERATE AN 80 ENERGY POINT KERNEL FOR $L = 0, 1, 2, 3$.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - A NEW CODE FLANGE2 IS UNDER DEVELOPMENT WITH SEVERAL ADDITIONS AND REFINEMENTS FOUND DESIRABLE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
IBM7044 VERSION SUBMITTED JUNE 1966.

10. REFERENCE - H. C. HONECK AND Y. D. NALIBOFF, MODIFICATION OF APPENDIX E INTEGRAL NEUTRON THERMALIZATION ANNUAL SUMMARY REPORT OCTOBER 1964 THROUGH SEPTEMBER 1965, GA-6824, MARCH 1966.
11. MACHINE REQUIREMENTS - 32K IBM7044 WITH 1 SCRATCH UNIT FOR KERNEL GENERATION PLUS INPUT, OUTPUT, AND SYSTEM TAPES
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM 7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
H. C. HONECK
DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY
U. S. ATOMIC ENERGY COMMISSION
WASHINGTON, D. C. 20545

Y. D. NALIBOFF
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE -
SOURCE DECK (856 CARDS)
REFERENCE REPORT
17. CATEGORY - A
KEYWORDS - SCATTERING LAW, CROSS SECTIONS, ANGULAR DISTRIBUTION

1. NAME OR DESIGNATION OF PROGRAM - COINC (COMPUTER CODE FOR REDUCTION OF COINCIDENCE COUNTING DATA)
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - COINCIDENCE COUNTING DATA ARE TREATED TO OBTAIN SPECIFIC DISINTEGRATION RATES, CHANNEL EFFICIENCIES AND COUNT RATES, WEIGHTED MEANS, AND ALL ASSOCIATED STANDARD ERRORS. CORRECTIONS ARE MADE FOR UNEQUAL DEADTIME LOSS IN EACH CHANNEL, COINCIDENCE RESOLVING TIME LOSSES, DECAY DURING COUNTING, DECAY FROM A REFERENCE TIME, AND BACKGROUND IN EACH OF THE THREE CHANNELS. INPUT VARIABLES INCLUDE SAMPLE IDENTIFICATION, START TIME FOR COUNTING, SAMPLE REFERENCE TIME, COUNTING INTERVAL, TOTAL NUMBER OF COUNTS IN TWO SINGLE CHANNELS AND ONE COINCIDENCE CHANNEL, AND NORMALIZING SAMPLE VOLUME. INPUT PARAMETERS CONSIST OF DEADTIMES OF EACH SINGLE CHANNEL, COINCIDENCE RESOLVING TIME FOR ALL THREE CHANNELS, DECAY CONSTANT, BACKGROUND COUNT RATE FOR ALL THREE CHANNELS, AND STANDARD ERRORS FOR EACH OF THE ABOVE PARAMETERS. OPTIONAL INPUT ALLOWS DATE, GROUP CLASSIFICATION, AND A 3-DIGIT USER CODE. OUTPUT CONTAINS CORRECTED SINGLE CHANNEL, COINCIDENCE, AND DISINTEGRATION RATES REFERRED TO START OF COUNT, SPECIFIC DISINTEGRATION RATE (COUNTS/SECOND/UNIT VOLUME OR WEIGHT) REFERRED TO REFERENCE TIME, WEIGHTED MEAN AND ERROR OF ANY NUMBER OF PROBLEMS IN A GROUP, EFFICIENCIES OF THE TWO INDEPENDENT DETECTOR CHANNELS, DATE, SUMMARY OF BACKGROUND VALUES USED, IDENTIFICATION NUMBER, COUNT START TIME, AND UPPER AND LOWER LIMIT (ONE STANDARD DEVIATION) OF EACH OF THE COMPUTED QUANTITIES.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
DECAY CONSTANT GREATER THAN ZERO
500 PROBLEMS PER SET FOR CDC3600
6. TYPICAL RUNNING TIME - 10 SECONDS ARE REQUIRED FOR A 50 CARD PROBLEM ON THE CDC3600.
7. UNUSUAL FEATURES OF THE PROGRAM - A VERY SIMPLE INPUT FORMAT IS AVAILABLE, ALLOWING APPLICATION TO ESSENTIALLY ANY COINCIDENCE DECAY SCHEME. INPUT DATA MAY BE TRANSCRIBED BY HAND AND PUNCHED FROM STANDARD FORMAT ONTO CARDS, OR AUTOMATICALLY PUNCHED CARD DATA MAY BE UTILIZED. MODIFICATIONS FOR PAPER TAPE ARE COMPLETE. COMPLEX ADJUSTMENTS OF THE ACCIDENTAL COINCIDENCE RATES AFFECTED BY DEADTIME ARE MADE. BOTH POISSON STATISTICS FOR TOTAL ACCUMULATED COUNTS AND ERROR PROPAGATION FOR CORRELATED AND UNCORRELATED QUANTITIES ARE COMPOUNDED IN DETERMINATION OF STANDARD DEVIATIONS. THE PROGRAM WAS DESIGNED FOR ABSOLUTE BETA-GAMMA COINCIDENCE COUNTING, BUT IT HAS ALSO BEEN USED FOR GAMMA-GAMMA AND NEUTRON-FISSION COINCIDENCE WORK. COMPENSATION FOR RADIOACTIVE DECAY CAN BE MADE TO ANY REFERENCE TIME FOR ANY NUMBER OF DAYS.

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8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
CDC3600 VERSION SUBMITTED JUNE 1966, SAMPLE PROBLEM EXECUTED BY ACC.
10. REFERENCES - A. DE VOLPI, K. G. PORGES AND G. JENSEN, COMPUTER CODE FOR REDUCTION OF COINCIDENCE COUNTING DATA, INTERNATIONAL JOURNAL OF APPLIED RADIATION AND ISOTOPES, VOL. 17, 1966.
G. JENSEN, COINC, FOR REDUCTION OF COINCIDENCE COUNTING DATA, ANL PROGRAM LIBRARY REPORT 1198/RP-258, JUNE 9, 1966.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN 63
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
A. DE VOLPI, K. G. PORGES, AND G. JENSEN
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439
16. MATERIAL AVAILABLE -
SOURCE DECK (3600-416 CARDS)
BINARY DECK (3600-217 CARDS)
SAMPLE PROBLEM (3600-31 CARDS)
REFERENCE REPORTS
17. CATEGORY - D
KEYWORDS - COINCIDENCE METHODS, STATISTICS, DECAY MEASUREMENTS,
DATA PROCESSING

1. NAME OR DESIGNATION OF PROGRAM - LASER
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - LASER IS BASED ON MODIFIED VERSIONS OF THE SLOWING-DOWN PROGRAM MUFT AND THE THERMALIZATION TRANSPORT THEORY PROGRAM THERMOS, AND PERFORMS A CALCULATION OF THE NEUTRON SPECTRUM IN A UNIFORM LATTICE MADE UP OF CYLINDRICAL RODS, CLADDING, AND SURROUNDING MODERATOR. THE THERMAL CUTOFF IN LASER IS 1.855 EV. THE PROGRAM PERFORMS A BURNUP CALCULATION FOR THE LATTICE. THE SPATIAL DISTRIBUTION OF BURNUP WITHIN THE FUEL RODS IS EXPLICITLY CALCULATED. THE PROGRAM WILL, AT OPTION, ACCOUNT FOR ALL NON-LINEARITIES AND MUTUAL CONNECTIONS IN THE SYSTEM OF BURNUP EQUATIONS. THIS CALCULATION ACCOUNTS FOR THE VARIATION OF THE NEUTRON FLUX IN SPACE AND ENERGY DURING EACH TIME-STEP. A BUCKLING AND A BORON POISON SEARCH (CRITICALITY SEARCH) ARE PROVIDED AS OPTIONS. OUTPUT INCLUDES EDITS IN THE ENERGY RANGE ZERO LESS THAN OR EQUAL TO E LESS THAN OR EQUAL TO 0.625 EV.
4. METHOD OF SOLUTION - THE METHODS USED IN SOLVING THE NEUTRON TRANSPORT EQUATION ARE ESSENTIALLY THOSE UTILIZED BY THE MUFT AND THERMOS PROGRAMS. THE NON-LINEAR EFFECTS IN THE BURNUP EQUATIONS ARE ACCOUNTED FOR BY COMPUTING THE RATE OF CHANGE OF THE NEUTRON FLUX WITH TIME AND BY USING THE RUNGE-KUTTA NUMERICAL PROCEDURE TO RECOVER THE FLUX AS A FUNCTION OF TIME. THE DEPLETION EQUATIONS ARE SOLVED BY ASSUMING A POLYNOMIAL EXPANSION FOR EXPONENTIAL FUNCTIONS. THE PRODUCTION AND LOSS OF CHAIN MEMBERS DURING IRRADIATION ARE EVALUATED BY SIMPLE MATRIX ALGEBRA. THE PROCEDURE ALLOWS FOR A TIME-DEPENDENT FLUX, IN THE FORM OF A POWER SERIES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THIS VERSION OF LASER IS RESTRICTED TO ONE-DIMENSIONAL, CYLINDRICAL GEOMETRY. THE MAXIMUM NUMBER OF SPACE POINTS IS 14, WITH A MAXIMUM OF 5 SPACE POINTS IN THE FUEL REGION. THE CODE IS RESTRICTED TO 4 MIXTURES (FUEL, CLADDING, MODERATOR, AND NON-ABSORBING HEAVY SCATTERER). THE MODERATOR CAN BE EITHER LIGHT WATER (NELKIN OR FREE GAS SCATTERING KERNEL), OR HEAVY WATER (NELKIN SCATTERING KERNEL). THE CLADDING MATERIAL CAN BE STAINLESS STEEL, ALUMINUM OR ZIRCALLOY-2. THE FUEL CAN BE A METAL, OXIDE OR CERMET. THE EPITHERMAL AND FAST ENERGY RANGES INCLUDE 50 ENERGY GROUPS. THE THERMAL RANGE INCLUDES 35 ENERGY GROUPS. ONLY THE U235 CHAIN (THROUGH U236) AND THE U238 CHAIN (THROUGH PU242) ARE AVAILABLE IN THE CODE. THE FISSION PRODUCTS ARE SEPARATED INTO XE135, THE DIRECTLY PRODUCED SM149, AND ALL OTHER FISSION PRODUCTS LUMPED INTO ONE PSEUDO FISSION PRODUCT. THE CROSS SECTIONS FOR THE LUMPED FISSION PRODUCTS ARE REPRESENTED BY POLYNOMIALS IN THE BURNUP. THE SPATIAL DISTRIBUTION OF U238 RESONANCE CAPTURES WITHIN THE FUEL RODS IS INPUT.

6. TYPICAL RUNNING TIME - THE GREATER PART OF THE LASER EXECUTION TIME IS CONSUMED BY THE THERMOS CALCULATION. EXECUTION TIMES FOR NO-BURNUP CASES ARE APPROXIMATELY 1-2 MINUTES WHEN THE MAXIMUM NUMBER OF SPACE POINTS IS SPECIFIED. FOR A BURNUP PROBLEM, EXECUTION TIME IS 1-2 MINUTES WHEN THE LINEAR APPROXIMATION IS CHOSEN, AND 4-6 MINUTES WHEN NON-LINEAR EFFECTS ARE INCLUDED.
7. UNUSUAL FEATURES OF THE PROGRAM - THE PROGRAM PROVIDES A COMPLETE EDIT FOR THE LATTICE IN THE ENERGY RANGE ZERO LESS THAN OR EQUAL TO E LESS THAN OR EQUAL TO TEN MEV, INCLUDING INTEGRAL QUANTITIES AND HOMOGENIZED FEW-GROUP CROSS SECTIONS. THE USER HAS A CHOICE OF THERMAL NEUTRON SCATTERING KERNELS, RESONANCE SELF-SHIELDING TREATMENTS, AND CELL CRITICALITY SEARCHES. A LINEAR AND A NON-LINEAR TREATMENT OF THE BURNUP EQUATIONS ARE PROVIDED. THE DETAILED SPATIAL BURNUP DISTRIBUTION WITHIN THE FUEL RODS IS TAKEN INTO ACCOUNT. A BURNUP PROBLEM CAN BE CONTINUED AFTER ANY TIME-STEP, BY USING A SPECIAL INPUT DECK PUNCHED AFTER EACH TIME-STEP.
8. RELATED AND AUXILIARY PROGRAMS - LIBP4 GENERATES THE THERMAL LIBRARY TAPE. SIG1 CONVERTS, BY INTERPOLATION, THE CROSS SECTION DATA CORRESPONDING TO A GIVEN ENERGY MESH TO CROSS SECTION DATA SUITABLE FOR INPUT TO THE LIBP4 PROGRAM.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
IBM7094 VERSION SUBMITTED AUGUST 1966.
10. REFERENCES - C. G. PONCELET, BURNUP PHYSICS OF HETEROGENEOUS REACTOR LATTICES, WCAP-6069, JUNE 1965.
C. G. PONCELET, LASER - A DEPLETION PROGRAM FOR LATTICE CALCULATIONS BASED ON MUFT AND THERMOS, WCAP-6073, APRIL 1966.
11. MACHINE REQUIREMENTS - 32K IBM7094, 7090, 7094-II WITH OVERLAY TAPE, LIBRARY TAPE, AND 3 SCRATCH TAPES
12. PROGRAMMING LANGUAGES USED - LASER, LIBP4, AND SIG1 ARE WRITTEN ENTIRELY IN FORTRAN IV. THE MUFT LIBRARY IN LASER IS IN MAP.
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN IV MONITOR.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
C. G. PONCELET
ATOMIC POWER DIVISIONS
PWR PLANTS DIVISION
WESTINGHOUSE ELECTRIC CORPORATION
P. O. BOX 355
PITTSBURGH, PENNSYLVANIA 15230

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (10621 CARDS)
SOURCE DECKS (LASER, LIBP4, AND SIG1)
SAMPLE PROBLEMS (LASER AND LIBP4)
MUFT LIBRARY (LASER)
REFERENCE REPORTS
17. CATEGORY - B
KEYWORDS - SLOWING DOWN, THERMALIZATION, SPECTRA, LATTICES, DEPLETION, 1-DIMENSIONAL, CYLINDERS, CRITICALITY SEARCHES, LIBP4 CODES, SIG1 CODES

1. NAME OR DESIGNATION OF PROGRAM - SAFE-PCRS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - SAFE-PCRS NUMERICALLY DETERMINES THE STRESS AND STRAIN DISTRIBUTION WITHIN EITHER HOMOGENEOUS OR HETEROGENEOUS THICK-WALLED BODIES OF REVOLUTION. IT IS DESIGNED FOR THE ANALYSIS OF MULTI-MATERIAL AXISYMMETRIC COMPOSITE STRUCTURES SUCH AS REINFORCED AND/OR PRESTRESSED CONCRETE VESSELS. DEFORMATIONS MUST BE WITHIN THE ELASTIC LIMIT OF THE MATERIALS CONSIDERED AND ONLY BODIES OF REVOLUTION SUBJECTED TO AXISYMMETRIC LOADING CAN BE TREATED.
4. METHOD OF SOLUTION - SAFE-PCRS EMPLOYS THE FINITE ELEMENT METHOD. A REFERENCE GRID DEFINING THE ELEMENTS MAY BE GENERATED BY HAND, BY COMPUTER, OR BY A COMBINATION OF THE TWO. THE VERTICES OF THE ELEMENTS ARE CALLED NODES. EACH NODE HAS TWO DEGREES OF FREEDOM, TRANSLATION IN THE RADIAL AND IN THE AXIAL DIRECTION. A DISPLACEMENT FUNCTION FOR THE GENERAL ELEMENT IS ASSUMED IN THE FORM OF POLYNOMIALS. BY MATRIX FORMULATION AND MANIPULATION, THE INTERNAL POTENTIAL ENERGY IS ADDED TO THE EXTERNAL POTENTIAL ENERGY OF THE SYSTEM. THE TOTAL ENERGY IS MINIMIZED BY DIFFERENTIATION AND THE STATIC EQUILIBRIUM OF THE STRUCTURE DETERMINED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF NODES = 1200
MAXIMUM NUMBER OF ELEMENTS = 2250
NOT VALID FOR INCOMPRESSIBLE MATERIALS
6. TYPICAL RUNNING TIME - 24 MINUTES ARE REQUIRED FOR A FULL CAPACITY PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - SAFE-AXISYM (ACC ABSTRACT 251) THE METHOD OF SOLUTION IS ITERATIVE IN SAFE-AXISYM AS OPPOSED TO THE DIRECT METHOD USED IN SAFE-PCRS AND THE CAPACITY OF SAFE-AXISYM IS REDUCED ALLOWING ALL COMPUTATION IN THE 32K CORE. AN AUXILIARY PROGRAM HAS BEEN WRITTEN TO PRODUCE A PLOT TAPE FOR THE SC-4020 RECORDER FROM THE STRESS TAPES WRITTEN BY SAFE-PCRS.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
IBM7044 VERSION SUBMITTED AUGUST 1966.
10. REFERENCES - D. C. CORNELL, SAFE-PCRS, A COMPUTER PROGRAM FOR THE STRESS ANALYSIS OF COMPOSITE BODIES OF REVOLUTION - INPUT INSTRUCTIONS, GA-6588, AUGUST 1, 1965.
YUSEF R. RASHID, ANALYSIS OF AXISYMMETRIC COMPOSITE STRUCTURES BY THE FINITE ELEMENT METHOD, GA-6763, OCTOBER 15, 1965.

10. REFERENCES (CONTINUED)
PRESTRESS CONCRETE REACTOR VESSELS ANALYTICAL METHODS
DEVELOPMENT, GACD-7258, JUNE 1966.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM 7040/7044 OPERATING SYSTEM (16/32K), VERSION IX. TAPE UNIT
ASSIGNMENTS ARE AS FOLLOWS -
B5 STRESS TAPE
C5 STRESS TAPE
C6 STIFFNESS TAPE
C7 DISPLACEMENT TAPE
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
FOUR COMPUTER TAPES CAN BE GENERATED ON EACH ORIGINAL RUN OF THE
PROGRAM. ALL TAPES MUST BE USED ON EACH RUN, REGARDLESS OF THEIR
EVENTUAL USE.
15. NAME AND ESTABLISHMENT OF AUTHOR -
O. C. CORNELL
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1571 CARDS)
SAMPLE PROBLEM (87 CARDS)
REFERENCE REPORTS
17. CATEGORY - I
KEYWORDS - STRESSES DISTRIBUTION, STRUCTURAL ANALYSIS, ELASTICITY,
DEFORMATION

1. NAME OR DESIGNATION OF PROGRAM - SAFE-AXISYM
2. COMPUTER FOR WHICH PROGRAM IS WRITTEN AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - SAFE-AXISYM IS A PROGRAM FOR THE ANALYSIS OF MULTI-MATERIAL AXISYMMETRIC COMPOSITE STRUCTURES. IT IS DESIGNED FOR THE ANALYSIS OF HETEROGENEOUS STRUCTURES SUCH AS REINFORCED AND/OR PRESTRESSED CONCRETE VESSELS. THE STRUCTURE IS ASSUMED TO BE LINEARLY ELASTIC, AND ONLY BODIES OF REVOLUTION SUBJECTED TO AXISYMMETRIC LOADING CAN BE TREATED.
4. METHOD OF SOLUTION - SAFE-AXISYM USES A FINITE ELEMENT METHOD WITH A MODIFIED GAUSS-SEIDEL ITERATION SCHEME. A REFERENCE GRID SUBDIVIDES THE STRUCTURE INTO RING-LIKE SMALL, FINITE ELEMENTS, THE VERTICES OF WHICH ARE CALLED NODES. THE GRID MAY BE GENERATED BY HAND, BY THE COMPUTER OR BY A COMBINATION OF THE TWO METHODS. EACH NODE HAS TWO DEGREES OF FREEDOM, TRANSLATION IN THE RADIAL AND IN THE AXIAL DIRECTION. BOTH ZERO AND NON-ZERO FIXED DISPLACEMENT CONSTRAINTS MAY BE ASSUMED, AND THE LOADING CONDITION MAY BE MECHANICAL AND/OR THERMAL.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MULTI-MATERIAL STRUCTURES WITH VARYING RIGIDITIES CONVERGE VERY SLOWLY.
NOT VALID FOR INCOMPRESSIBLE MATERIALS.
MAXIMUM NUMBER OF NODES = 475
MAXIMUM NUMBER OF ELEMENTS = 1100
6. TYPICAL RUNNING TIME - 12 MINUTES ARE REQUIRED FOR A FULL CAPACITY PROBLEM. THE NUMBER OF ITERATIONS REQUIRED TO REACH STATIC EQUILIBRIUM IS DEPENDENT ON THE NUMBER OF NODES, STRUCTURAL FLEXIBILITY, LOADING CONDITION, AND NODE-NUMBERING SEQUENCE. A STRUCTURE OF MODERATE SIZE AND FLEXIBILITY WILL USUALLY CONVERGE IN 300 TO 400 ITERATIONS.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - SAFE-AXISYM IS PRIMARILY INTENDED FOR THICK-WALLED STRUCTURES WHERE BENDING IS SMALL. EXTREMELY FLEXIBLE STRUCTURES SUCH AS LONG, THIN, Laterally-Loaded BEAMS CONVERGE VERY SLOWLY AND SAFE-PCRS (ACC ABSTRACT 250) SHOULD BE USED RATHER THAN SAFE-AXISYM FOR PROBLEMS OF THIS TYPE. AN AUXILIARY PROGRAM HAS BEEN WRITTEN TO PRODUCE A PLOT TAPE FOR THE SC-4020 RECORDER FROM THE STRESS TAPES WRITTEN BY SAFE-AXISYM.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
IBM7044 VERSION SUBMITTED AUGUST 1966.
10. REFERENCES - D. C. CORNELL, SAFE-AXISYM, A COMPUTER PROGRAM FOR THE DESIGN OF COMPOSITE BODIES OF REVOLUTION - INPUT INSTRUCTIONS, GA-6697, OCTOBER 15, 1965.

10. REFERENCES (CONTINUED)

YUSEF R. RASHID, ANALYSIS OF AXISYMMETRIC COMPOSITE STRUCTURES BY THE FINITE ELEMENT METHOD, GA-6763, OCTOBER 15, 1965.

PRESTRESS CONCRETE REACTOR VESSELS ANALYTICAL METHODS DEVELOPMENT, GACD-7258, JUNE 1966.

11. MACHINE REQUIREMENTS - 32K MEMORY

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
IBM 7040/7044 OPERATING SYSTEM (16/32K), VERSION IX.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

D. C. CORNELL
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (990 CARDS)
SAMPLE PROBLEM (1010 CARDS)
REFERENCE REPORTS

17. CATEGORY - 1

KEYWORDS - STRUCTURAL ANALYSIS, ELASTICITY, HETEROGENEOUS,
STRESSES

REACTOR CODE ABSTRACT 252

10/67

1. NAME OR DESIGNATION OF PROGRAM - SAFE-PLANE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108
3. NATURE OF PHYSICAL PROBLEM SOLVED - SAFE-PLANE IS APPLIED TO TWO-DIMENSIONAL STRUCTURES OF ARBITRARY GEOMETRY UNDER IN-PLANE LOADS. EITHER PLANE STRESS OR PLANE STRAIN CONDITIONS MAY BE IMPOSED. MECHANICAL AND/OR THERMAL LOADS ARE PERMITTED.
4. METHOD OF SOLUTION - THE FINITE ELEMENT METHOD IS USED TO CONSTRUCT A MATHEMATICAL MODEL BY ASSEMBLING DISCRETE ELEMENTS. THE TOTAL POTENTIAL ENERGY OF THE STRUCTURE IS DETERMINED AND SUBSEQUENTLY MINIMIZED BY ITERATION ON COMPONENTS OF THE DISPLACEMENT FIELD UNTIL STATIC EQUILIBRIUM OF THE STRUCTURE IS ATTAINED. STRAINS AND STRESSES ARE COMPUTED FROM THE RESULTING DISPLACEMENTS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MULTI-MATERIAL STRUCTURES WITH VARYING RIGIDITIES CONVERGE VERY SLOWLY.
NOT VALID FOR INCOMPRESSIBLE MATERIALS.
MAXIMUM NUMBER OF NODAL POINTS = 675
MAXIMUM NUMBER OF ELEMENTS = 1350
6. TYPICAL RUNNING TIME - LESS THAN 3 MINUTES ARE REQUIRED FOR A FULL CAPACITY PROBLEM ON THE 1108.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - OTHER PROGRAMS USEFUL FOR STRESS ANALYSIS OF PRESTRESSED CONCRETE REACTOR VESSELS ARE SAFE-AXISYM (ACC ABSTRACT 251) AND SAFE-PCRS (ACC ABSTRACT 250) FOR AXISYMMETRIC COMPOSITE STRUCTURES AND SAFE-SHELL (ACC ABSTRACT 253) FOR THIN SHELLS OF REVOLUTION. ON THE 1108, ICON2 (A CONTOUR PLOTTING PROGRAM) PLOTS THE POINTWISE STRESS/STRAIN OUTPUT AS A SERIES OF EQUAL INTENSITY CONTOURS.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
IBM7044 VERSION SUBMITTED AUGUST 1966, DELETED OCTOBER 1967.
UNIVAC1108 VERSION SUBMITTED OCTOBER 1967.
10. REFERENCES - INPUT INSTRUCTIONS FOR SAFE-PLANE COMPUTER PROGRAM.
YUSEF R. RASHID, ANALYSIS OF AXISYMMETRIC COMPOSITE STRUCTURES BY THE FINITE ELEMENT METHOD, GA-6763, OCTOBER 15, 1965.
PRESTRESS CONCRETE REACTOR VESSELS ANALYTICAL METHODS DEVELOPMENT, GACD-7250, JUNE 1966.
D. C. CORNELL, SAFE-PLANE, A COMPUTER PROGRAM FOR THE STRESS ANALYSIS AND DESIGN OF TWO-DIMENSIONAL COMPOSITE BODIES, A USERS MANUAL, GA-7851, JUNE 30, 1967.

11. MACHINE REQUIREMENTS - APPROXIMATELY 47000 WORDS (BASE 10) PLUS THE OPERATING SYSTEM (1100). REQUIREMENTS CAN BE EASILY REDUCED BY SIMPLE ADJUSTMENT OF DIMENSION STATEMENTS.
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
D. C. CORNELL
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1108-1025 CARDS)
SAMPLE PROBLEM (1108-142 CARDS)
REFERENCE REPORTS
INPUT INSTRUCTIONS
17. CATEGORY - 1
KEYWORDS - STRUCTURAL ANALYSIS, STRESSES, 2-DIMENSIONAL

REACTOR CODE ABSTRACT 253

10/67

1. NAME OR DESIGNATION OF PROGRAM - SAFE-SHELL
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108
3. NATURE OF PHYSICAL PROBLEM SOLVED - SAFE-SHELL IS USED TO DESIGN AND ANALYZE AXISYMMETRIC THIN SHELL STRUCTURES OF ARBITRARY GENERATRICES UNDER AXISYMMETRIC MECHANICAL AND/OR THERMAL LOADING CONDITIONS. THE INTERSECTION OF TWO OR MORE SHELLS CAN BE TREATED.
4. METHOD OF SOLUTION - THE FINITE ELEMENT METHOD IS USED TO CONSTRUCT A MATHEMATICAL MODEL BY ASSEMBLING DISCRETE ELEMENTS. THE TOTAL POTENTIAL ENERGY OF THE STRUCTURE IS DETERMINED AND SUBSEQUENTLY MINIMIZED BY DIFFERENTIATING THE ENERGY FUNCTION WITH RESPECT TO EACH DISPLACEMENT COMPONENT. THE EQUILIBRIUM EQUATIONS ARE THEN SOLVED BY TRI-DIAGONALIZATION. STRAINS AND STRESSES ARE COMPUTED FROM THE RESULTING DISPLACEMENT FIELD.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 MAXIMUM NUMBER OF NODAL POINTS = 181
 MAXIMUM NUMBER OF ELEMENTS = 180
 CAPACITY CAN BE EASILY INCREASED AT COST OF STORAGE REQUIREMENTS.
6. TYPICAL RUNNING TIME - LESS THAN 3 MINUTES ARE REQUIRED FOR A FULL CAPACITY PROBLEM ON THE 1108.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - OTHER PROGRAMS USEFUL FOR STRESS ANALYSIS OF PRESTRESSED CONCRETE REACTOR VESSELS ARE SAFE-AXISYM (ACC ABSTRACT 251) AND SAFE-PCRS (ACC ABSTRACT 250) FOR AXISYMMETRIC COMPOSITE STRUCTURES AND SAFE-PLANE (ACC ABSTRACT 252) FOR PLANE STRUCTURES INVOLVING IN-PLANE STRESS DISTRIBUTIONS.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
 IBM7044 VERSION SUBMITTED AUGUST 1966, DELETED OCTOBER 1967.
 UNIVAC1108 VERSION SUBMITTED OCTOBER 1967.
10. REFERENCES - INPUT INSTRUCTIONS FOR SAFE-SHELL COMPUTER PROGRAM. FINITE ELEMENT ANALYSIS OF AXISYMMETRIC COMPOSITE STRUCTURES, GA-6303, JUNE 4, 1965.
 YUSEF R. RASHID, ANALYSIS OF AXISYMMETRIC COMPOSITE STRUCTURES BY THE FINITE ELEMENT METHOD, GA-6763, OCTOBER 15, 1965.
 PRESTRESS CONCRETE REACTOR VESSELS ANALYTICAL METHODS DEVELOPMENT, GACO-7258, JUNE 1966.
 D. C. CORNELL, SAFE-SHELL, A COMPUTER PROGRAM FOR THE STRESS ANALYSIS OF THIN-SHELL BODIES OF REVOLUTION, A USERS MANUAL, GA-7852, JUNE 30, 1967.

REACTOR CODE ABSTRACT 253

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11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
D. C. CORNELL
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1108-1195 CARDS)
SAMPLE PROBLEM (1108-41 CARDS)
REFERENCE REPORTS, GA-6763, GACD-7258, GA-7852
INPUT INSTRUCTIONS
17. CATEGORY - 1
KEYWORDS - STRUCTURAL ANALYSIS, SHELLS, STRESSES

REACTOR CODE ABSTRACT 254

10/67

1. NAME OR DESIGNATION OF PROGRAM - 2PLUS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094, CDC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE 2PLUS CODE SOLVES THE PROBLEM OF THE SCATTERING OF CHARGED OR UNCHARGED NUCLEONS BY A NUCLEUS REPRESENTED BY A DEFORMED NUCLEAR POTENTIAL. THE MODEL ASSUMES THAT THE TARGET NUCLEUS HAS A 0+ GROUND STATE AND A 2+ FIRST EXCITED LEVEL, AND THE INTERACTION POTENTIAL HAS A QUADRUPOLE DEFORMATION. A HAUSER-FESHBACH COMPOUND NUCLEUS CALCULATION HAS BEEN INCLUDED. THE OUTPUT CONTAINS TOTAL, POTENTIAL ELASTIC, POTENTIAL INELASTIC (2+), REACTION, AND COMPOUND NUCLEUS CROSS SECTIONS AS WELL AS ELASTIC AND INELASTIC ANGULAR DISTRIBUTIONS.
4. METHOD OF SOLUTION - A COUPLED SET OF SEVEN, COMPLEX SECOND-ORDER DIFFERENTIAL EQUATIONS IS SOLVED BY DIFFERENCE TECHNIQUES. THE ASYMPTOTIC SCATTERING SOLUTION BOUNDARY CONDITIONS ARE APPLIED USING A MATRIX INVERSION METHOD. THE BASIC THREE-DIMENSIONAL PROBLEM IS REDUCED TO ONE DIMENSION BY A SPHERICAL HARMONICS EXPANSION. EACH COEFFICIENT IN THAT EXPANSION YIELDS A SET OF COUPLED DIFFERENTIAL EQUATIONS AND SUFFICIENT TERMS MUST BE CALCULATED TO ENSURE CONVERGENCE. THE TERMS NEEDED INCREASE WITH ENERGY.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
12 LEVELS INCLUDING THE GROUND STATE
500 MESH POINTS FOR INTEGRATION
30 TERMS IN THE LEGENDRE EXPANSION
90 ANGLES
6. TYPICAL RUNNING TIME - APPROXIMATELY 1.5 MINUTES PER ENERGY POINT ARE REQUIRED INCLUDING PLOTTED, PRINTED, AND PUNCHED OUTPUT ON THE 7094. A ROUGH ESTIMATE IS GIVEN BY
$$T(\text{MIN}) = .003 * L_{\text{MAX}} * N_{\text{MAX}} * \text{NUMBER OF ENERGY POINTS}$$
WHERE L_{MAX} = NUMBER OF TERMS IN THE LEGENDRE EXPANSION
 N_{MAX} = NUMBER OF MESH POINTS FOR INTEGRATION
3 MINUTES AND 40 SECONDS WERE REQUIRED TO RUN THE 3600 SAMPLE PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM - THIS IS A TWO LINK CHAIN PROGRAM. THE SECOND LINK PLOTS EXPERIMENTAL AND THEORETICAL DATA USING AN SC-4020 GRAPHICAL DISPLAY DEVICE.
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
IBM7094 VERSION SUBMITTED OCTOBER 1966.
CDC3600 VERSION SUBMITTED JULY 1967, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - C. L. DUNFORD, 2 PLUS, A NONSPHERICAL OPTICAL MODEL FOR FAST NEUTRON CROSS SECTIONS, NAA-SR-11706, JULY 1966.
M. HOFFMAN AND W. A. RHODES, AICRT3, A GENERAL CODE FOR DISPLAY OF DIGITAL DATA, NAA-SR-MEMO-9069, OCTOBER 1963.
11. MACHINE REQUIREMENTS - 32K MACHINE
12. PROGRAMMING LANGUAGES USED - FORTRAN II (7094) AND FORTRAN 63 (3600)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN MONITOR AND SCOPE.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - IF AN SC-4020 DEVICE IS NOT AVAILABLE, THEN THE SECOND LINK SHOULD BE REMOVED. OTHERWISE, THE FORTRAN II AICRT3 SUBROUTINE AND THE NAA SC-4020 SUBROUTINE PACKAGE ARE AVAILABLE THROUGH -
UAIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA
15. NAME AND ESTABLISHMENT OF AUTHORS -
7094 C. L. DUNFORD
EXPERIMENTAL ANALYSIS UNIT
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA

3600 MRS. DOROTHY BINGAMAN
REACTOR PHYSICS DIVISION
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7094-3537 CARDS, 3600-3294 CARDS)
BINARY DECK (3600-1481 CARDS)
SAMPLE PROBLEMS (7094-31 CARDS, 3600-32 CARDS)
REFERENCE REPORTS
17. CATEGORY - A
KEYWORDS - COMPOUND NUCLEUS, HAUSER-FESHBACH THEORY, CROSS SECTIONS, ELASTIC SCATTERING, INELASTIC SCATTERING, ANGULAR DISTRIBUTION, OPTICAL MODEL

1. NAME OR DESIGNATION OF PROGRAM - R101
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600, IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - R101 SOLVES THE SPACE-INDEPENDENT, ONE-ENERGY GROUP REACTOR KINETICS EQUATIONS TO DETERMINE THE TIME VARIATION OF NEUTRON DENSITY GIVEN SPECIFIED INITIAL CONDITIONS. ANY OF FOUR PROGRAMMED REPRESENTATIONS OF EXCESS REACTIVITY CAN BE SELECTED.
4. METHOD OF SOLUTION - THE METHOD OF SOLUTION WAS ORIGINALLY DESCRIBED IN ANL-5577.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
MAXIMUM NUMBER OF DELAY GROUPS = 20
6. TYPICAL RUNNING TIME - APPROXIMATELY 360 CALCULATIONS PER SECOND CAN BE PERFORMED ON THE CDC3600.
7. UNUSUAL FEATURES OF THE PROGRAM - AN INTERRUPT FACILITY IS INCORPORATED WHICH PERMITS PARAMETER CHANGES AND EDIT OR TERMINATION WHEN A SPECIFIED VALUE OF A PARAMETER IS ATTAINED.
8. RELATED AND AUXILIARY PROGRAMS - R102 (ACC ABSTRACT 168) IS THE INVERSE PROGRAM.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
CDC3600 VERSION SUBMITTED OCTOBER 1966, SAMPLE PROBLEM EXECUTED BY ACC.
IBM7094 VERSION SUBMITTED NOVEMBER 1966.
10. REFERENCES - J. J. KAGANOVE, REACTOR KINETICS, R101 AND PROGRAM LIBRARY REPORT, OCTOBER 7, 1964.
R. O. BRITTAN, SOME PROBLEMS IN THE SAFETY OF FAST REACTORS, ANL-5577.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN 63 (CDC3600) AND FORTRAN IV (IBM7094)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - CDC3600 SCOPE AND IBM7094 IBSYS OPERATING SYSTEMS.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

CDC3600

J. J. KAGANOVE
APPLIED MATHEMATICS DIVISION
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IBM7094

L. I. ORTENBERG AND P. J. SIPUSH
WESTINGHOUSE ASTRONUCLEAR LABORATORY
P. O. BOX 10864
PITTSBURGH, PENNSYLVANIA

16. MATERIAL AVAILABLE -

SOURCE DECKS (3600-439 CARDS, 7094-392 CARDS)

BINARY DECK (3600-165 CARDS)

SAMPLE PROBLEMS (3600-36 CARDS, 7094-36 CARDS)

REFERENCE REPORT, AND PROGRAM LIBRARY REPORT

17. CATEGORY - E

KEYWORDS - SPACE-INDEPENDENT KINETICS, REACTIVITY

1. NAME OR DESIGNATION OF PROGRAM - MANTA
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635
3. NATURE OF PHYSICAL PROBLEM SOLVED - MANTA IS A PROGRAM WHICH PROVIDES A THERMAL-HYDRAULIC NODAL ANALYSIS IN THE STEADY STATE. IT WAS DESIGNED TO ANALYZE FUEL ELEMENT CONFIGURATION IN THE SUPER-HEAT DEVELOPMENT PROGRAM. MANTA ANALYZES MIXING BETWEEN COOLANT CHANNELS, ALLOWS FOR TEMPERATURE VARIANT CONDUCTIVITY IN ADMITTANCE CALCULATION, AND MULTIPLE STACKED SEGMENTS THROUGH THE FUEL REGION FOR A 7 ELEMENT CLUSTER ANALYSIS OVER A LENGTH OF UP TO 8 FEET. MANTA IS DESIGNED FOR SINGLE-PASS STEAM FLOW. THE FLOW DIRECTION IN THE COOLANT CHANNELS MAY BE EITHER UP OR DOWN, THEREBY PERMITTING THE ANALYSIS OF TWO-PASS AS WELL AS SINGLE-PASS FUEL ELEMENTS. MANTA ACCOUNTS FOR THE HEAT TRANSFER AND PRESSURE DROP THAT MAY OCCUR BETWEEN COOLANT CHANNELS DUE TO MIXING AS WELL AS TO THE CONVENTIONAL HEAT TRANSFER AND PRESSURE DROP RELATIONSHIPS DUE TO FRICTION, DISCONTINUITIES, ACCELERATION, CONVECTION, CONDUCTION, AND RADIATION. MANTA ALLOWS FOR THE CALCULATION AT EACH NODE OF THE MATERIAL PROPERTIES VISCOSITY, SPECIFIC HEAT, CONDUCTIVITY, AND SPECIFIC VOLUME TO CORRESPOND TO THE ACTUAL NODE TEMPERATURE BEING SOLVED FOR.
4. METHOD OF SOLUTION - THE PROGRAM EMBODIES TWO INDEPENDENT ANALYTICAL SOLUTIONS. THE SOLUTION PROCEEDS BY SOLVING FOR THE NODE TEMPERATURES OF THE FIRST SEGMENT, EVALUATING THE CHANGE IN COOLANT TEMPERATURE, AND PROCEEDING TO CALCULATE THE TEMPERATURES OF THE SECOND SEGMENT. THIS PROCESS CONTINUES UNTIL ALL SEGMENT TEMPERATURES HAVE BEEN EVALUATED. A PRESSURE DROP CHECK ON EACH COOLANT CHANNEL IS THEN MADE WHICH REQUIRES THAT ALL CHANNEL PRESSURE DROPS BE WITHIN SPECIFIED INPUT VALUES. IF THESE VALUES ARE NOT CONVERGED, A NEW FLOW RATE FOR EACH CHANNEL IS DERIVED AND THE SOLUTION REPEATED UNTIL CONVERGENCE IS ACHIEVED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
 - 200 NODES
 - 1 TO 100 INTERNAL NODES
 - 101 TO 150 SURFACE NODES
 - 48 COOLANT NODES
 - 24 COOLANT CHANNELS
 - 20 SEGMENTS
 - 6 CONNECTIONS PER NODE EXCEPT FOR THE COOLANT NODES WHICH HAVE 5
6. TYPICAL RUNNING TIME - ABOUT THREE SECONDS PER NODE ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - MANTA USES THE TIGER5 METHOD FOR THERMAL-HYDRAULICS CALCULATIONS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
GE635 VERSION SUBMITTED NOVEMBER 1966.
10. REFERENCES - S. F. ARMOUR AND D. L. SMITH, MANTA-MIXING ANALYZED
NODAL THERMAL-HYDRAULIC ANALYSIS, GEAP-4805, FEBRUARY 1965.
DESCRIPTION-STEAM PROPERTY FUNCTIONS, 11 F001-F029.
NELS J. ANDERSON, JR., IDFTAP, A FORTRAN IV FUNCTION
SUBPROGRAM, S6T001, JANUARY 15, 1965.
11. MACHINE REQUIREMENTS - 35K GE635, WITH 3 SCRATCH TAPES
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
GE635 GECOS.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
MANTA REQUIRES THE USE OF STEAM PROPERTIES WHICH ARE NOT SUPPLIED,
BUT A SUBROUTINE WRITEUP IS INCLUDED. A TAPE DEFINITION SUBROU-
TINE WRITEUP IS ALSO INCLUDED.
15. NAME AND ESTABLISHMENT OF AUTHORS -
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SAN JOSE, CALIFORNIA 95125

B. G. ATRAZ
ADVANCED PRODUCTS OPERATION
GENERAL ELECTRIC COMPANY
310 DE GUIGNE DRIVE
SUNNYVALE, CALIFORNIA 94086
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (635-4779 CARDS)
SAMPLE PROBLEM (635-206 CARDS)
REFERENCE REPORTS
17. CATEGORY - H
KEYWORDS - FUEL ELEMENTS, TEMPERATURE DISTRIBUTION, HEAT TRANSFER,
FLUID FLOW

1. NAME OR DESIGNATION OF PROGRAM - REAX
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635
3. NATURE OF PHYSICAL PROBLEM SOLVED - REAX CALCULATES EPITHERMAL FLUX, ACTIVITIES AND CROSS SECTIONS AS A FUNCTION OF RADIUS AND ENERGY FOR A CONSTANT TEMPERATURE FUEL ROD IMMERSSED IN A HOMOGENEOUS MEDIUM.
4. METHOD OF SOLUTION - REAX CALCULATES PSI AND CHI FUNCTIONS AND RESONANCE CROSS SECTIONS AS A FUNCTION OF ENERGY FOR EACH RESONANCE OF EACH MATERIAL. FOR HYPERFINE GROUP STRUCTURE, REAX CALCULATES SOURCES AND FLUXES AT A SPECIFIED RADIUS USING ACCUMULATED CROSS SECTIONS FROM ALL NEIGHBORING RESONANCES. REAX INTEGRATES FLUXES AND CROSS SECTIONS OVER INPUT ENERGY RANGES TO OBTAIN AVERAGE VALUES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
 - 5 FUEL TEMPERATURES
 - 5 MODERATING MATERIALS
 - 3 FUEL ISOTOPES
 - 30 FIRST FERTILE ISOTOPE RESONANCES
 - 10 SECOND FERTILE ISOTOPE RESONANCES
 - 80 FISSILE ISOTOPE RESONANCES
6. TYPICAL RUNNING TIME - A PROBLEM CONSISTING OF 27 RESONANCES AND 2500 HYPERFINE GROUPS TAKES ABOUT TWO MINUTES PER SPECIFIED RADIUS.
7. UNUSUAL FEATURES OF THE PROGRAM - REAX INCLUDES PROVISIONS FOR BACKGROUND CROSS SECTION APPROXIMATIONS AND FOR INTERFERENCE SCATTERING IN THE FIRST FERTILE ISOTOPE.
8. RELATED AND AUXILIARY PROGRAMS - REAX IS AN EXTENSION OF THE COMPUTER CODE DOPIE (ACC ABSTRACT 177).
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
GE635 VERSION SUBMITTED NOVEMBER 1966.
10. REFERENCES - R. PROTSIK, EPITHERMAL CAPTURE AND FISSION DISTRIBUTION IN A FUEL ROD - THE COMPUTER CODE REAX, GEAP-4973, APRIL 1966.
NELS J. ANDERSON, JR., IDFTAP, A FORTRAN IV FUNCTION SUBPROGRAM, S6T001, JANUARY 15, 1965.
11. MACHINE REQUIREMENTS - 35K GE635 WITH INPUT AND OUTPUT MEDIA
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GE635 GECOS.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. PROTSIK
ADVANCED PRODUCTS OPERATION
GENERAL ELECTRIC COMPANY
310 DE GUIGNE DRIVE
SUNNYVALE, CALIFORNIA 94086
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (635-1645 CARDS)
SAMPLE PROBLEM (635-47 CARDS)
REFERENCE REPORTS
17. CATEGORY - B
KEYWORDS - CELL CALCULATION, RESONANCE PARAMETERS, EPITHERMAL,
CROSS SECTIONS, CAPTURE, FISSION

REACTOR CODE ABSTRACT 258

10/67

1. NAME OR DESIGNATION OF PROGRAM - EXPN
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635
3. NATURE OF PHYSICAL PROBLEM SOLVED - EXPN ANALYZES PULSED NEUTRON DATA USING THE GARELIS-RUSSEL TECHNIQUE (REFERENCE 1). BASICALLY THE CODE COMPUTES THE PROMPT DECAY CONSTANT, ALPHA, AND THE PARAMETER ($K \cdot \text{BETA}/L$) FROM EXPERIMENTAL DATA, WHICH IS DIRECTLY EXTRACTED FROM A TIME ANALYZER STORAGE MEMORY AND READ ONTO A PUNCHED PAPER TAPE. THE ALPHA-DETERMINATION PART OF THE CODE WAS ORIGINALLY OBTAINED UNDER THE NAME EXPLICIT FROM KNOLLS ATOMIC POWER LABORATORY BUT HAS SINCE BEEN MODIFIED. THE CODE PROVIDES OPTIONS FOR A PRE-BURST OR A POST-BURST BACKGROUND ANALYSIS. THAT IS, THE PARAMETERS ALPHA AND ($K \cdot \text{BETA}/L$) ARE OBTAINED USING A BACKGROUND MEASURED PRIOR TO THE BURST OR MEASURED AFTER THE BURST.
4. METHOD OF SOLUTION - USING A WEIGHTED LEAST SQUARES TECHNIQUE THE DECAY CONSTANT ALPHA IS DETERMINED ASSUMING AN EXPONENTIAL DECAY, $\text{EXP}(\text{ALPHA} \cdot T)$. AN ITERATIVE TYPE CALCULATION IS USED TO DETERMINE THE PARAMETER ($K \cdot \text{BETA}/L$). THE PULSED SOURCE INDUCED DELAYED NEUTRON BACKGROUND IS COMPUTED AND CORRECTED FOR ANY EXTRANEIOUS SOURCE CONTRIBUTION. THESE CONTRIBUTIONS APPEAR AS A SEPARATE INPUT AND ARE NORMALIZED BY THE CODE TO THE NUMBER OF SWEEPS OF THE PROBLEM. THE SWEEPS REFER TO THE REPETITION RATE OF THE TIME ANALYZER. THAT IS, THE TIME ANALYZER REPETITION RATE CAN BE DIFFERENT FROM THE REPETITION RATE OF THE PULSED NEUTRON SOURCE.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - A MAXIMUM OF - 256 CHANNELS
6. TYPICAL RUNNING TIME - 6 SECONDS PER SAMPLE ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM - EXPN WILL ACCEPT PAPER TAPE INPUT PROVIDED THE PAPER TAPE IS CONVERTED TO CARD IMAGES PRIOR TO INPUT TO THE PROGRAM.
8. RELATED AND AUXILIARY PROGRAMS - THIS PROGRAM HAS BEEN PREVIOUSLY CALLED *EDSPUNS, OR EXPLICIT.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
GE635 VERSION SUBMITTED NOVEMBER 1966.
10. REFERENCES - E. GARELIS AND J. L. RUSSELL, JR., THEORY OF PULSED NEUTRON SOURCE MEASUREMENTS, NUCLEAR SCIENCE AND ENGINEERING, VOL. 16, PP. 263-270, 1963.
E. GARELIS AND P. MEYER, DEVELOPMENT OF PULSED NEUTRON APPLICATION TO POWER REACTOR START-UP PROCEDURES - SEVENTH AND EIGHTH QUARTERLY PROGRESS REPORTS, GEAP-4606, OCTOBER 1, 1963 - MARCH 31, 1964.
P. MEYER AND C. L. PETERSON, EXPN, JANUARY 14, 1964.

10. REFERENCES (CONTINUED)

NELS J. ANDERSON, JR., IDFTAP, A FORTRAN IV FUNCTION
SUBPROGRAM, S6T001, JANUARY 15, 1965.

11. MACHINE REQUIREMENTS - 35K MACHINE WITH INPUT AND OUTPUT MEDIA

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
GE635 GECOS AND PHILCO 2000 SMART OPERATING SYSTEMS.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (635-1308 CARDS)
SAMPLE PROBLEM (635-360 CARDS)
REFERENCE REPORTS, EXPN AND IDFTAP

17. CATEGORY - 0

KEYWORDS - DECAY MEASUREMENTS, DATA PROCESSING, LEAST SQUARES

REACTOR CODE ABSTRACT 259

10/67

1. NAME OR DESIGNATION OF PROGRAM - MUSCAT
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108
3. NATURE OF PHYSICAL PROBLEM SOLVED - MUSCAT COMPUTES THE INCIDENT SCATTERED NEUTRON CURRENTS AS A FUNCTION OF POSITION WITHIN (1) THE CAVITY FORMED BY TWO TRUNCATED CONCENTRIC SPHERES, (2) THE CAVITY BETWEEN TWO CONCENTRIC CIRCULAR CYLINDERS, OR (3) A CYLINDRICAL CAVITY.
4. METHOD OF SOLUTION - THE CONCEPT OF VIEW FACTORS HAS BEEN UTILIZED. THE VIEW FACTOR IS DEFINED AS THE FRACTION OF NEUTRONS, LEAVING ONE SURFACE IN ALL DIRECTIONS, WHICH IS INTERCEPTED BY A SECOND SURFACE. IF THERE ARE N DIFFERENT SURFACE AREAS, A SYSTEM OF N ALGEBRAIC EQUATIONS IN N UNKNOWN IS USED TO YIELD THE VALUES OF THE TOTAL INCIDENT NEUTRON CURRENTS. DOUBLE INTEGRALS ARE REDUCED TO SINGLE INTEGRALS FOR COMPUTATION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE GEOMETRY OF THE CAVITY IS LIMITED TO THE THREE CASES ENUMERATED IN ITEM 3.
6. TYPICAL RUNNING TIME - AN EXECUTION TIME OF 1 TO 2 MINUTES IS REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
UNIVAC1108 VERSION SUBMITTED DECEMBER 1966.
10. REFERENCE - M. J. GERBER AND B. W. ROOS, MUSCAT, A FORTRAN IV VIEW FACTOR SHIELDING CODE, GAMD-6775, DECEMBER 6, 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - UNIVAC 1108 EXEC II OPERATING SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
M. J. GERBER AND B. W. ROOS
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

REACTOR CODE ABSTRACT 259

-2-

10/67

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3455 CARDS)
SAMPLE PROBLEM (81 CARDS)
REFERENCE REPORT
17. CATEGORY - J
KEYWORDS - SCATTERING, NEUTRONS, CURRENTS, SHIELDING

REACTOR CODE ABSTRACT 260

10/67

1. NAME OR DESIGNATION OF PROGRAM - GARGOYLE
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7044
3. NATURE OF PHYSICAL PROBLEM SOLVED - GARGOYLE IS AN INFINITE MEDIUM DEPLETION CODE FOR FUEL CYCLE CALCULATIONS ON REACTORS EMPLOYING PARTIAL REFUELING. THE BURNUP OF UP TO 12 DISCRETE FUEL COMPOSITIONS (REGIONS OR STAGES OF IRRADIATION) MAY BE FOLLOWED SIMULTANEOUSLY. THE BURNUP CALCULATION MAY BE INTERRUPTED PERIODICALLY TO REMOVE THE CONTENTS OF AND TO REFUEL ONE OR MORE REGIONS. FUEL MAY BE COMPLETELY OR PARTIALLY RECYCLED. A CONTROL POISON SEARCH MAY BE PERFORMED AT EACH TIME-STEP. FEED FUEL SEARCHES ARE PERMITTED AT THE END OF EACH BURNUP CYCLE BEFORE REFUELING. CONCENTRATION DEPENDENT SELF-SHIELDING FACTORS MAY BE APPLIED TO ANY NUCLIDE EXCEPT MODERATORS. THE NUCLIDE SCHEME EMPLOYED, ALTHOUGH NOT COMPLETELY GENERAL, IS FLEXIBLE.
4. METHOD OF SOLUTION - ALL REGIONS ARE ASSUMED TO BE SUBJECTED TO THE SAME NEUTRON FLUX AND THE DEPLETION CALCULATIONS ARE PERFORMED WITH A SERIES OF SHORT TIME-STEPS. AFTER EACH TIME-STEP THE FLUX AMPLITUDE IS RENORMALIZED TO THE POWER AND THE SPECTRUM MAY BE RECALCULATED AFTER A SPECIFIED SERIES OF THESE STEPS. THE FEED SEARCH OBTAINS THE END OF THE BURNUP CYCLE MULTIPLICATION FACTOR WITHIN TOLERANCE LIMITS BY REPEATING THE BURNUP CALCULATIONS BETWEEN GIVEN TIME INTERVALS USING IMPROVED VALUES FOR THE AMOUNT OF FEED MATERIAL. THE IMPROVED VALUES ARE OBTAINED BY LINEAR INTERPOLATION OF THE RESULTS OF PREVIOUS TRIALS. THE CONTROL SEARCHES OPERATE SIMILARLY EXCEPT THAT CONTROL POISON CONCENTRATION IS ADJUSTED AND NO BURNUP CALCULATIONS ARE INVOLVED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
 - 12 ENERGY GROUPS
 - 12 FUEL COMPOSITIONS OR REGIONS
 - 40 NUCLIDES PER REGION
 - 25 HEAVY NUCLIDES (PRODUCING FISSION PRODUCTS)
 - 3 NUCLIDES WITH FULL THERMAL TRANSFER MATRIX
6. TYPICAL RUNNING TIME - 1 TO 30 MINUTES ARE REQUIRED DEPENDING PRIMARILY UPON THE NUMBER OF TIME-STEPS AND SEARCH REQUIREMENTS.
7. UNUSUAL FEATURES OF THE PROGRAM - GARGOYLE IS AN ATTEMPT TO COMPLETELY AUTOMATE THE PROCESS OF DETERMINING THE FEED MATERIAL REQUIREMENTS DURING THE APPROACH TO EQUILIBRIUM.
8. RELATED AND AUXILIARY PROGRAMS - THIS CODE IS AN EXTENSION OF THE METHODS USED IN THE REVISED GAD CODE (ACC ABSTRACT 223).
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
IBM7044 VERSION SUBMITTED DECEMBER 1966.

10. REFERENCE - F. W. TODT, GARGOYLE - AN INFINITE MEDIUM FUEL CYCLE ANALYSIS CODE WITH FUEL AND POISON SEARCHES, GA-6622, FEBRUARY 12, 1966.
11. MACHINE REQUIREMENTS - 32K IBM7044 WITH THREE TAPES (INPUT, OUTPUT, AND SYSTEM)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM 7040/7044 OPERATING SYSTEM (16/32K), VERSION 1X.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - GARGOYLE CONTAINS MANY USEFUL OPTIONS BUT IS NOT VERY EFFICIENT. ALL OPTIONS HAVE NOT BEEN TESTED.
15. NAME AND ESTABLISHMENT OF AUTHOR -
F. W. TODT
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (4002 CARDS)
SAMPLE PROBLEM (551 CARDS)
REFERENCE REPORT
17. CATEGORY - D
KEYWORDS - DEPLETION, FUEL CYCLE, INFINITE MEDIA, CONTROL SEARCHES

1. NAME OR DESIGNATION OF PROGRAM - GADDOSE/DOSET
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE GADDOSE PROGRAM CALCULATES RADIOACTIVITY AND DOSES RESULTING FROM INSTANTANEOUS ACCIDENTAL RELEASE OF ACTIVITY WHILE THE COMPANION PROGRAM DOSET INCLUDES THE EFFECTS OF A TIME-DEPENDENT ACCIDENTAL FISSION PRODUCT RELEASE FOR THE HTGR TYPE OF PLANT. GIVEN AN INITIAL FISSION PRODUCT INVENTORY RELEASED INTO A REACTOR VESSEL OR CONTAINMENT VOLUME, THE QUANTITY OF EACH ISOTOPE IS CALCULATED AT A NUMBER OF TIMES AT A NUMBER OF LOCATIONS (IN THE CONTAINMENT, CONTAINMENT RECIRCULATING CLEANUP FILTERS, LEAK COLLECTOR, PLANT EXHAUST FILTERS AND IN THE ATMOSPHERE AT A NUMBER OF DISTANCES FROM THE PLANT). EACH DECAY CHAIN IS CALCULATED SEPARATELY CONSIDERING BUILDUP AND DECAY OF EACH ISOTOPE. RADIOLOGICAL DOSES ARE CALCULATED FOR ANY THREE BODY ORGANS AND THE WHOLE BODY BASED ON METEOROLOGICAL AND PHYSIOLOGICAL INPUT PARAMETERS. FALLOUT AND RAINOUT ARE INCLUDED.
4. METHOD OF SOLUTION - THE ARRAY OF FIRST ORDER LINEAR DIFFERENTIAL EQUATIONS DESCRIBING THE PHYSICAL SYSTEM (A 6-ISOTOPE UNIVERSAL DECAY CHAIN WITH 5 PHYSICAL LOCATIONS) WAS SOLVED AND THE RESULTING ALGEBRAIC EXPRESSIONS PROGRAMMED TO SHORTEN RUNNING TIME. THE COMPUTATIONS ARE A SERIES OF EXACT SOLUTIONS AT THE SPECIFIED TIMES.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE PROBLEM IS RESTRICTED TO 5 TIME SOLUTIONS AND 5 DOSE-DISTANCE SOLUTIONS. THERE IS NO LIMIT ON THE NUMBER OF DECAY CHAINS BUT EACH CHAIN IS LIMITED TO 6 ISOTOPES. DOSET ACCEPTS UP TO 8 DISCRETE FISSION PRODUCT ACTIVITY ADDITIONS AS A FUNCTION OF TIME.
6. TYPICAL RUNNING TIME - ON THE UNIVAC 1108 GADDOSE SUMMATION PRINTOUT REQUIRES 30 SECONDS, WHILE GADDOSE LONG PRINT OF ALL ISOTOPES TAKES 1 MINUTE. DOSET SUMMATION PRINTOUT REQUIRES 1 MINUTE, WHILE DOSET LONG PRINT OF ALL ISOTOPES TAKES 2 MINUTES.
7. UNUSUAL FEATURES OF THE PROGRAM - THE ALGEBRAIC SOLUTIONS OF THE DIFFERENTIAL EQUATIONS ARE PROGRAMMED RATHER THAN SOLVING THE PROBLEM BY A NUMERICAL INTEGRATION SCHEME.
8. RELATED AND AUXILIARY PROGRAMS - THERE ARE TWO VERSIONS OF GADDOSE, THE DIFFERENCE BEING THE OUTPUT PROVIDED. GADDOSE1 PRINTS ALL OF THE ACTIVITIES AND DOSES FOR EACH ISOTOPE. GADDOSE2 HAS A CONDENSED EDIT OF ONLY THE ACTIVITIES AND DOSE SUMMATIONS BY ISOTOPE CLASSIFICATION.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
UNIVAC1108 VERSION SUBMITTED DECEMBER 1966.

10. REFERENCE - E. LEE, R. J. MACK, AND D. B. SEDGLEY, GADDOSE AND DOSET - PROGRAMS TO CALCULATE ENVIRONMENTAL CONSEQUENCES OF RADIOACTIVITY RELEASE, GA-6511, APRIL 25, 1966.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - UNIVAC1108 EXEC II OPERATING SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - INPUT REQUIRES FISSION PRODUCT DECAY CHAIN LIBRARY INCLUDING ISOTOPE CURIES, DECAY CONSTANTS, BRANCHING RATIOS, BETA OR GAMMA ENERGY, AND BIOLOGICAL DOSE EFFECTIVITY (REM/CURIE INHALED), IN ADDITION TO PHYSICAL PARAMETERS FOR STRUCTURAL LEAKAGE, RECIRCULATION, FILTER EFFICIENCY, AND METEOROLOGICAL DATA.
15. NAME AND ESTABLISHMENT OF AUTHOR -
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SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1108-5726 CARDS)
REFERENCE REPORT
17. CATEGORY - G
KEYWORDS - RADIOACTIVITY, DOSE RATES, FISSION PRODUCTS, HTGR REACTORS, ATMOSPHERE, ISOTOPES, DECAY, PRODUCTION, INSTANTANEOUS RELEASE

1. NAME OR DESIGNATION OF PROGRAM - MACH1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - COC3600
3. NATURE OF PHYSICAL PROBLEM SOLVED - MACH1 PERFORMS ONE-DIMENSIONAL MULTIGROUP DIFFUSION SOLUTIONS AND ASSOCIATED CALCULATIONS, INCLUDING CRITICALITY SEARCHES, PERTURBATION, REACTION SUMMARY, BETA EFFECTIVE, GROUP COLLAPSING, AND POINTWISE REACTION RATES AND RATIOS. SEVERAL CARD DUMPS OF COMPUTED DATA ARE AVAILABLE ON OPTION.
4. METHOD OF SOLUTION - THE DIFFUSION EQUATION SOLUTION METHOD IS THE SAME AS THAT IN AIM6 (ACC ABSTRACT 29). PERTURBATION AND EFFECTIVE BETA ROUTINES HAVE BEEN ADAPTED FROM DEL AND 1188/RE. REMAINING COMPUTATIONS CONSIST OF STRAIGHTFORWARD DATA MANIPULATION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
 - 20 SPATIAL REGIONS
 - 150 MESH POINTS
 - 30 ENERGY GROUPS
 - 15 DOWNSCATTER GROUPS
 - 20 ISOTOPES PER PROBLEM
 - 20 HOMOGENIZED MATERIALS
 - 20 ISOTOPES PER HOMOGENIZED MATERIALA SPECIAL SCATTER TREATMENT IS USED WHICH ALLOWS FULL DOWNSCATTER FOR HYDROGEN ISOTOPES.
6. TYPICAL RUNNING TIME - RUNNING TIME IS STRONGLY DEPENDENT ON THE TYPE OF PROBLEM AND QUALITY OF INITIAL GUESS. A K-CALCULATION OF A WATER-MODERATED SYSTEM WITH 16 GROUPS, 5 DOWNSCATTER GROUPS, 20 REGIONS, AND 130 MESH POINTS, WITH A CONSTANT INITIAL SOURCE GUESS CONVERGED IN 11 INNER ITERATIONS TO WITHIN $10^{-5}(\Delta K/K)$ IN 46.5 SECONDS. A COMPOSITION SEARCH ON A FAST REACTOR CORE USING 22 GROUPS, 12 DOWNSCATTERS, 9 REGIONS, 150 MESH POINTS, AND REGION-DEPENDENT INITIAL SOURCE GUESS, CONVERGED WITH A TOTAL OF 19 INNER ITERATIONS AND 3 TRIALS TO $10^{-6}(\Delta K/K)$, FOUND THE ADJOINT SOLUTION TO THE SAME ACCURACY AND RAN A SINGLE PERTURBATION PASS IN 144.9 SECONDS.
7. UNUSUAL FEATURES OF THE PROGRAM - THE PROGRAM WAS DESIGNED FOR USE ON FAST REACTOR SURVEY COMPUTATIONS AND AS A SUPPORTING UTILITY FOR MORE COMPLEX PROGRAMS. PROBLEMS CAN BE RUN IN SEQUENCE WITH ONLY REQUIRED DATA CHANGES AS INPUT FOR PROBLEMS AFTER THE FIRST. THE PROGRAM CONTAINS A CALL TO A NON-EXISTENT OVERLAY. THIS CAN PROVIDE A LINK TO ANY ROUTINE WRITTEN BY THE USER FOR MODIFICATION OR MANIPULATION OF MACH1 OUTPUT DATA. THE ROUTINE HAS ACCESS TO INPUT DATA AND DATA GENERATED BY THE CODE, AND CAN CONTROL LATER PROBLEMS THROUGH OPTION SWITCHES. MICROSCOPIC CROSS SECTIONS MAY BE CALLED FROM A LIBRARY OR INPUT AT RUN TIME. INDIVIDUAL CROSS SECTION QUANTITIES MAY BE MODIFIED TEMPORARILY FOR A PROBLEM.

8. RELATED AND AUXILIARY PROGRAMS - AIM6, DEL, AND 1188/RE WERE ADAPTED AND MODIFIED TO MAKE UP THE MAJOR PORTIONS OF THE PROGRAM.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
CDC3600 VERSION SUBMITTED DECEMBER 1966.
10. REFERENCES - D. A. MENELEY, L. C. KVITEK, AND D. M. OSHEA, MACH 1, A ONE-DIMENSIONAL DIFFUSION THEORY PACKAGE, ANL-7223, JUNE 1966.
H. P. FLATT AND D. C. BALLER, THE AIM-6 CODE, NAA PROGRAM DESCRIPTION, JANUARY 1961.
L. C. KVITEK, DEL, A PERTURBATION PROGRAM WRITTEN IN FORTRAN, ANL-7052, JUNE 1965.
L. C. KVITEK, MULTIGROUP CALCULATIONS OF EFFECTIVE DELAYED-NEUTRON FRACTIONS, PROMPT NEUTRON LIFETIME, AND RELATED KINETICS PARAMETERS, IBM-704 PROGRAM 1188/RE, ANL-6511, MARCH 1962.
11. MACHINE REQUIREMENTS - CDC 3600 WITH 64K CORE STORAGE AND 9 TAPE DRIVES (INCLUDING 5 SYSTEM TAPES)
12. PROGRAMMING LANGUAGE USED - 3600 FORTRAN
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - CDC 3600 SCOPE-SATCOPS II.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE PROGRAM IS DIVIDED INTO SIX OVERLAYS WITH A TOTAL OF ELEVEN SEGMENTS. EXTENSIVE USE HAS BEEN MADE OF 3600 FORTRAN CAPABILITIES. APPROXIMATELY 51000 CORE CELLS ARE REQUIRED BY THE PROGRAM.
15. NAME AND ESTABLISHMENT OF AUTHOR -
D. A. MENELEY
BLDG. 208
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (MACH1 6980 CARDS, MACH1B 293 CARDS,
RXMACH 137 CARDS)
SAMPLE PROBLEMS (MACH-1.95 CARDS)
MEMORANDA - COMMON BLOCK DICTIONARY, MACH1 GUIDE
REFERENCE REPORT, ANL-7223
17. CATEGORY - C
KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, MULTIGROUP, SLABS, CYLINDERS, SPHERES, CRITICALITY SEARCHES, REACTION RATES, AVERAGES, PERTURBATION THEORY

1. NAME OR DESIGNATION OF PROGRAM - GASKET
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108
3. NATURE OF PHYSICAL PROBLEM SOLVED - GASKET CALCULATES THE THERMAL NEUTRON SCATTERING LAW, $S(\alpha, \beta)$, FOR A LARGE CLASS OF MODERATORS. PROVISION HAS BEEN MADE IN GASKET FOR THE FOLLOWING DYNAMICAL MODES OF THE SCATTERER -
 - (1) FREE TRANSLATION (GAS).
 - (2) DIFFUSIVE OR BROWNIAN MOTION.
 - (3) HARMONIC ISOTROPIC VIBRATIONS WITH CONTINUOUS FREQUENCY SPECTRUM.
 - (4) HARMONIC ANISOTROPIC VIBRATIONS WITH CONTINUOUS FREQUENCY SPECTRUM (AS APPLIED FOR INSTANCE TO GRAPHITE).
 - (5) HARMONIC ISOTROPIC VIBRATIONS WITH DISCRETE FREQUENCY SPECTRUM.
4. METHOD OF SOLUTION - NEUTRON SCATTERING KERNELS ARE OBTAINED FROM THE SCATTERING LAW USING THE RELATION

$$\text{SIGMA}(E_0 \text{ TO } E, \text{THETA}) = (\text{SIGMA}_0/4\pi) \cdot \text{SQRT}(E/E_0) \cdot \text{EXP}(-\text{BETA}/2) \cdot S(\alpha, \beta)$$
 WHERE E_0 AND E ARE, RESPECTIVELY, INITIAL AND FINAL NEUTRON ENERGIES, THETA IS THE COSINE OF THE NEUTRON SCATTERING ANGLE IN THE LABORATORY, AND α AND β ARE, RESPECTIVELY, DIMENSIONLESS MOMENTUM AND ENERGY TRANSFERS. GASKET CALCULATES S AT POINTS OF A 2-DIMENSIONAL α, β MESH. NUMERICAL METHODS ARE USED TO EVALUATE FOURIER TRANSFORMS OF S . FOR VERY LARGE VALUES OF α AND β AN OPTION IS INCLUDED TO USE WICKS SHORT COLLISION APPROXIMATION FOR S .
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA ARE -
 - 100 POINTS IN DISTRIBUTED FREQUENCY SPECTRUM
 - 100 POINTS IN ANISOTROPIC PART OF THE FREQUENCY SPECTRUM
 - 2 DISCRETE OSCILLATORS IF $W_{\text{SUB } 1}$ DOES NOT EQUAL ZERO, OTHERWISE 20
 - 20 PHONON TERMS CALCULATED FOR EACH DELTA LINE
6. TYPICAL RUNNING TIME - 5 MINUTES ARE REQUIRED ON THE 1108.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - AN AUXILIARY CODE, FLANGE (ACC ABSTRACT 247), IS USED TO GENERATE CROSS SECTION INFORMATION FROM THE SCATTERING LAW.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
UNIVAC1108 VERSION SUBMITTED DECEMBER 1966.
10. REFERENCE - J. U. KOPPEL, J. R. TRIPLET, AND Y. D. NALIBOFF, GASKET, A UNIFIED CODE FOR THERMAL NEUTRON SCATTERING, GA-7417, SEPTEMBER 11, 1966, AND ERRATA.

11. MACHINE REQUIREMENTS - 32K MACHINE WITH ABOUT 26K AVAILABLE FOR THE PROGRAM AND ONE SCRATCH UNIT (DRUM, DISK, OR TAPE)
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - UNIVAC 1108 EXEC II OPERATING SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
Y. D. NALIBOFF
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE -
SOURCE DECK (1108-1115 CARDS)
SAMPLE PROBLEM (1108-29 CARDS)
REFERENCE REPORT AND ERRATA
17. CATEGORY - A
KEYWORDS - SCATTERING LAW, INCOHERENT APPROXIMATION, MODERATORS

REACTOR CODE ABSTRACT 264

10/67

1. NAME OR DESIGNATION OF PROGRAM - VARI-QUIR3
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE STEADY-STATE, MULTIGROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y, R-Z, AND R-THETA GEOMETRY.
4. METHOD OF SOLUTION - A GAUSS-SEIDEL TYPE OF SOLUTION WITH INNER AND OUTER ITERATIONS IS USED. THE SOURCE IS HELD CONSTANT DURING THE INNER ITERATIONS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - THE RUNNING TIME IS A FUNCTION OF THE TYPE OF PROBLEM AND THE DEGREE OF CONVERGENCE WANTED.
7. UNUSUAL FEATURES OF THE PROGRAM - VARI-QUIR3 HAS COMPLETE VARIABLE DIMENSIONS AT EXECUTION TIME.
8. RELATED AND AUXILIARY PROGRAMS - VARI-QUIR (ACC ABSTRACT 212)
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
IBM7094 VERSION SUBMITTED JANUARY 1967.
10. REFERENCES - G. COLLIER, C. E. RIECK, AND J. W. RIESE, VARI-QUIR A TWO-DIMENSIONAL TIME-DEPENDENT MULTI-GROUP DIFFUSION CODE, WANL-TNR-133 REVISED, DECEMBER 1965.
G. COLLIER AND J. W. RIESE, VARI-QUIR III INCLUSION OF THE R-THETA GEOMETRY, WANL-TME-1526, OCTOBER 1966.
G. COLLIER AND J. W. RIESE, VARI-QUIR III, A TWO-DIMENSIONAL STEADY STATE MULTI-GROUP DIFFUSION CODE, WANL-TNR-189, DECEMBER 1964.
A. H. KILLINGER AND G. B. KILLINGER, DOUBLE INTERPOLATION SUBROUTINE, WESTINGHOUSE ANALYTICAL DEPARTMENT REPORT 62-1002, JANUARY 1962.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBSYS OPERATING SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE AUXILIARY ROUTINE POTLUX GENERATES A FLUX AND ADJOINT GUESS FOR A VARI-QUIR PROBLEM WHOSE INTERNAL REGION BOUNDARIES ARE DIFFERENT FROM THOSE OF A PREVIOUS PROBLEM USING THE FLUX AND ADJOINT FROM THAT PROBLEM. THIS ENABLES USERS TO VARY THE INTERFACES AT WILL AND STILL OPTIMIZE RUNNING TIME. VARI-QUIR III REQUIRES A DOUBLE INTERPOLATION SUBROUTINE.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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REACTOR PHYSICS AND MATHEMATICS
WESTINGHOUSE ASTRONUCLEAR LABORATORY
P. O. BOX 10864
PITTSBURGH, PENNSYLVANIA 15236

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECKS (VARI-QUIR3 1804 CARDS, POTLUK 494 CARDS)
SAMPLE PROBLEM (VARI-QUIR3 40 CARDS)
REFERENCE REPORTS, WANL-TNR-133 AND WANL-TME-1526

17. CATEGORY - C

KEYWORDS - DIFFUSION EQUATIONS, 2-DIMENSIONAL, MULTIGROUP, X-Y,
R-Z, R-THETA, FLUX DISTRIBUTION, REACTIVITY, POTLUK
CODES

REACTOR CODE ABSTRACT 265

10/67

1. NAME OR DESIGNATION OF PROGRAM - RSAC/DEP
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7040
3. NATURE OF PHYSICAL PROBLEM SOLVED - RSAC IS USED TO COMPUTE THE POTENTIAL RADIOLOGICAL DOSES RESULTING FROM EITHER A CONTINUOUS OR INSTANTANEOUS RELEASE OF RADIOACTIVE FISSION PRODUCTS TO THE ATMOSPHERE. THE DOSES CONSIDERED ARE CLOUD GAMMA, DEPOSITION GAMMA, INGESTION, AND INHALATION BASED UPON THE RELEASE OF UP TO 200 ISOTOPES, THE RELATIVE ABUNDANCE OF EACH ISOTOPE DEPENDENT UPON THE OPERATING HISTORY OF THE REACTOR. EFFECTS OF NEUTRON ACTIVATION ARE NEGLECTED BUT IF KNOWN, CAN BE ADDED TO THE FISSION YIELDS.
4. METHOD OF SOLUTION - THE RATE OF BUILDUP OR FISSION PRODUCT GENERATION OF THE VARIOUS ISOTOPES OF A DECAY CHAIN OR THE DECAY RATE IS DETERMINED BY THE GENERAL SOLUTION OF A SET OF FIRST-ORDER SIMULTANEOUS DIFFERENTIAL EQUATIONS. THE RATE OF ATMOSPHERIC DIFFUSION IS COMPUTED FROM AN ANALYTIC FORMULATION DUE TO SUTTON. THE LEAKAGE RATE IS DETERMINED AS AN APPROXIMATION TO THE ACTUAL CONTAINMENT VESSEL LEAKAGE RATE AND CHAMBERLAIN'S DEPLETION MODEL IS USED TO COMPENSATE FOR CLOUD DEPLETION, IF DESIRED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
100 DECAY CHAINS
450 ISOTOPES UNLESS A DEPOSITION GAMMA DOSE IS REQUIRED, THEN
330 ISOTOPES
25 DOWNWIND AND CROSSWIND POSITIONS EACH
20 ELEMENTS TO BE FRACTIONATED IF FRACTIONATION BY ELEMENTS IS CHOSEN
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - THE AUXILIARY PROGRAM DEP READS THE DATA NEEDED FOR THE RSAC PROGRAM AND ESTIMATES THE NUMBER OF LINES OF OUTPUT AND THE CALCULATION TIME REQUIRED. IT HAS THE SAME ERROR COMMENTS AS RSAC AND PRINTS ALL DATA PERTAINING TO EACH PROBLEM AS WELL AS COMMENT CARDS.
9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
IBM7040 VERSION SUBMITTED JANUARY 1967.
10. REFERENCE - R. L. COATES AND N. R. HORTON, RSAC, A RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM, IDO-17151, MAY 1966.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - MAP

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
R. L. COATES AND N. R. HORTON
ATOMIC ENERGY DIVISION
PHILLIPS PETROLEUM COMPANY
IDAHO FALLS, IDAHO
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SYMBOLIC DECKS (RSAC 5025 CARDS, DEP 741 CARDS)
BINARY DECKS (RSAC 434 CARDS, DEP 166 CARDS)
SAMPLE PROBLEM (532 CARDS)
REFERENCE REPORT
17. CATEGORY - G
KEYWORDS - RADIOACTIVITY, CONTINUOUS RELEASE, INSTANTANEOUS
RELEASE, FISSION PRODUCTS, ATMOSPHERE, DOSE RATES,
DEP CODES

REACTOR CODE ABSTRACT 266

12/67

1. NAME OR DESIGNATION OF PROGRAM - CYGRO2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600
3. NATURE OF PHYSICAL PROBLEM SOLVED - CYGRO2 IS USED TO DETERMINE STRESSES AND STRAINS DURING STEADY-STATE AND TRANSIENT POWER OPERATION OF AN OXIDE-FUELED, METAL CLAD ROD-TYPE FUEL ELEMENT IN A PRESSURIZED ENVIRONMENT. MAJOR LOADING CONDITIONS INCLUDE FUEL SWELLING, FISSION GAS AND COOLANT PRESSURE, CLAD GROWTH AND DIFFERENTIAL THERMAL EXPANSION. THE APPLICATION FOR WHICH THE PROGRAM HAS BEEN DEVELOPED IS ZIRCALOY TUBES CONTAINING BULK OXIDE FUEL. AXIAL AND AZIMUTHAL SYMMETRY OF TEMPERATURE AND STRESSES IS ASSUMED.
4. METHOD OF SOLUTION - THE INITIAL FORCES, DIMENSIONS, STRESSES AND STRAINS ARE ASSUMED KNOWN. FUEL AND CLAD ARE CONSIDERED PARTITIONED INTO CONCENTRIC RINGS WITH STRESSES, STRAINS AND MATERIAL PROPERTIES ASSUMED UNIFORM THROUGHOUT. STRAIN RATES, EXPRESSED IN TERMS OF DEFORMATION RATES, ARE RELATED TO STRESS RATES BY THE PRANDTL-REUSS EQUATIONS MODIFIED TO INCLUDE THERMAL EXPANSION, GROWTH, PLASTICITY, AND CREEP. THE INTERNAL STRAIN ENERGY RATE IN A RING IS EQUATED TO THE EXTERNAL WORK RATE TO OBTAIN EQUILIBRIUM EQUATIONS RELATING RING BOUNDARY LOADS TO STRESSES AND, IN TURN, RING DEFORMATION RATES. THESE FLEXIBILITY EQUATIONS AND THE BOUNDARY CONDITION EQUATIONS ARE THEN SOLVED TO GIVE THE LOAD AND DEFORMATION RATES OF EACH RING AND, IN TURN, STRESS AND STRAIN RATES ARE DETERMINED. THE SIZE OF THE TIME INCREMENT IS RESTRICTED SO THAT MAXIMUM CHANGES IN STRESS AND STRAIN DO NOT EXCEED SPECIFIED LIMITS. ALL RATES ARE MULTIPLIED BY THE TIME INCREMENT AND ADDED TO THE VALUE OF THE CORRESPONDING VARIABLE AT THE START OF THE TIME-STEP TO DETERMINE THEIR VALUES AT THE END. THIS PROCEDURE IS REPEATED UNTIL THE END OF THE PROBLEM.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
54 RINGS
5 GAS PORE REGIONS
6. TYPICAL RUNNING TIME -
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - CYGRO1. THE MAIN DIFFERENCE BETWEEN THE TWO PROGRAMS IS THE TREATMENT OF FUEL SWELLING BY IRRADIATION. IN CYGRO2 THERMAL CONDUCTIVITY IS A FUNCTION OF BOTH TEMPERATURE AND POROSITY, AND ELASTIC-PLASTIC-CREEP DATA ARE GIVEN IN A TABLE OF PROPERTIES FOR FOUR TEMPERATURES INSTEAD OF THREE AS IN CYGRO1.
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
CDC6600 VERSION SUBMITTED JANUARY 1967.

10. REFERENCES - C. M. FRIEDRICH AND W. H. GUILINGER, CYGRO-2, A FORTRAN IV COMPUTER PROGRAM FOR STRESS ANALYSIS OF THE GROWTH OF CYLINDRICAL FUEL ELEMENTS WITH FISSION GAS BUBBLES, WAPD-TM-547, NOVEMBER 1966.
C. M. FRIEDRICH, CYGRO-1, STRESS ANALYSIS OF THE GROWTH OF CONCENTRIC CYLINDERS, WAPD-TM-514, OCTOBER 1965, AND ADDENDUM 1, JULY 1966.
C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THERE ARE CALLS MADE TO A TIMING ROUTINE TICK WHICH IS A SYSTEM SUBROUTINE AND IS NOT INCLUDED IN THE CDC-6600 FORTRAN PROGRAMMING BETTIS ENVIRONMENTAL REPORT PACKAGE.
15. NAME AND ESTABLISHMENT OF AUTHORS -
C. M. FRIEDRICH AND W. H. GUILINGER
WESTINGHOUSE ELECTRIC CORPORATION
BETTIS ATOMIC POWER LABORATORY
PITTSBURGH, PENNSYLVANIA
16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL (2 TAPES)
SOURCE DECK (3356 CARDS)
BETTIS ENVIRONMENTAL ROUTINES (21,125 CARDS)
REFERENCE REPORTS, WAPD-TM-547, WAPD-TM-668
17. CATEGORY - I
KEYWORDS - STRESSES DISTRIBUTION, FUEL ELEMENTS, DEFORMATION, TEMPERATURE, PRESSURE

1. NAME OR DESIGNATION OF PROGRAM - WATER
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - PHILCO 2000-212
3. NATURE OF PHYSICAL PROBLEM SOLVED - WATER IS A SUBROUTINE USED TO EXTRACT THERMODYNAMIC AND TRANSPORT PROPERTIES OF LIQUID, VAPOR, AND SUPERCRITICAL WATER BY TABULAR INTERPOLATION OVER THE RANGE OF STATES - 14.5 TO 14,500 PSIA AND 32 TO 1472 DEGREES F. THESE PROPERTIES ARE SPECIFIC VOLUME, SPECIFIC ENTHALPY, DYNAMIC VISCOSITY, AND THERMAL CONDUCTIVITY, TABULATED FOR PRESSURE AND TEMPERATURE CONDITIONS.
4. METHOD OF SOLUTION - THE PRINCIPAL SOURCE OF DATA IS THE SKELETON TABLES ADOPTED BY THE SIXTH INTERNATIONAL CONFERENCE ON THE PROPERTIES OF STEAM. BI-LINEAR INTERPOLATION IN PRESSURE AND TEMPERATURE IS USED FOR INTERPOLATING THE SINGLE-PHASE PROPERTY TABLES WHILE A CUBIC FUNCTION IS USED TO INTERPOLATE THE SATURATION CURVES AS A FUNCTION OF A SINGLE INDEPENDENT VARIABLE, EITHER PRESSURE OR TEMPERATURE. THE ABILITY TO ASSOCIATE A PROPERTY AND DERIVATIVE WITH A STATE OUTSIDE THE TABLE LIMITS HAS BEEN INCLUDED. THE PROPERTY IS FORMED BY LINEARLY EXTRAPOLATING THE TABULAR DATA AT CONSTANT PRESSURE AND/OR CONSTANT TEMPERATURE. THE PRESSURE OR TEMPERATURE GRADIENT AT THE CLOSEST BOUNDARY IS TAKEN AS THE DERIVATIVE. THE RECIPROCAL OF PRESSURE WAS USED AS AN AUXILIARY COORDINATE TO IMPROVE THE LINEAR INTERPOLATION IN THE SPECIFIC VOLUME.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE LARGEST ERRORS FOR ENTHALPY, SPECIFIC HEAT, SPECIFIC VOLUME, AND THERMAL CONDUCTIVITY OCCUR NEAR THE SATURATION CURVE, ESPECIALLY NEAR THE CRITICAL POINT. THE LARGEST ERROR IN VISCOSITY OCCURS AT LOW TEMPERATURES.
6. TYPICAL RUNNING TIME - 2 TO 6.5 MILLISECONDS ARE REQUIRED FOR ONE PROPERTY PLUS TWO DERIVATIVES, I.E. ONE TABLE LOOK-UP.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
PHILCO 2000 VERSION SUBMITTED FEBRUARY 1967.
10. REFERENCE - W. A. COFFMAN AND L. L. LYNN, WATER, A LARGE RANGE THERMODYNAMIC AND TRANSPORT WATER PROPERTY FORTRAN IV COMPUTER PROGRAM, WAPD-TM-568, DECEMBER 1966.
11. MACHINE REQUIREMENTS - THE STORAGE REQUIRED FOR THE PROPERTY DATA IS 2877 LOCATIONS. TOTAL STORAGE REQUIREMENT IS ABOUT 4000 LOCATIONS. THERE ARE NO TAPE REQUIREMENTS.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
BK58.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
THE WATER SUBROUTINE PACKAGE IS USED BY THE FORTRAN IV CALL -
CALL WATER (P, H, T, X, PROP, N)
P = PRESSURE, PSIA
H = ENTHALPY, BTU/LB
T = TEMPERATURE, DEGREE F
X = QUALITY DEFINED BY $(H - H_F)/(H_G - H_F)$
PROP = A 1-DIMENSIONAL ARRAY OF DIMENSIONS (AT LEAST 21 USED
FOR PROPERTIES AND DERIVATIVES AS SUBROUTINE OUTPUT).
N = AN INTEGER SET TO INDICATE WHICH PROPERTIES ARE TO BE
DETERMINED AND WHETHER H, T, OR X IS TO BE SUPPLIED IN
ADDITION TO P.
A SEPARATE SUBROUTINE PACKAGE PROVIDES SATURATED DATA IN TERMS OF
ONE INDEPENDENT VARIABLE BY THE FORTRAN IV CALL -
CALL SATVLU (R1, R2, R3, R4, X, IND)
R1 = SATURATION PROPERTY
R2 = SATURATION PROPERTY SLOPE
R3 = SATURATION VAPOR PROPERTY
R4 = SATURATION VAPOR PROPERTY SLOPE
X = INDEPENDENT PROPERTY
IND = INDICATOR SET TO SPECIFY WHAT THE INDEPENDENT PROPERTY
IS TOGETHER WITH WHAT PROPERTIES AND DERIVATIVES ARE TO
BE SUPPLIED.
15. NAME AND ESTABLISHMENT OF AUTHORS -
W. A. COFFMAN AND L. L. LYNN
WESTINGHOUSE ELECTRIC CORPORATION
BETTIS ATOMIC POWER LABORATORY
BOX 79
WEST MIFFLIN, PENNSYLVANIA 15122
16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
SOURCE DECK (756 CARDS)
REFERENCE REPORT
17. CATEGORY - H
KEYWORDS - THERMODYNAMICS, WATER, PRESSURE, TEMPERATURE, LIQUIDS,
VAPORS

REACTOR CODE ABSTRACT 268

12/67

1. NAME OR DESIGNATION OF PROGRAM - TRANS-FUGUE1
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094
3. NATURE OF PHYSICAL PROBLEM SOLVED - TRANS-FUGUE1 IS A TRANSIENT SINGLE CHANNEL, TWO-PHASE FLOW, AND HEAT TRANSFER CODE FOR ANALYSIS OF POSTULATED REACTOR INCIDENTS INVOLVING BOILING. THE CODE IS BASED ON A HOMOGENEOUS HYDRODYNAMIC MODEL WHICH ASSUMES EQUAL PHASE TEMPERATURES AND VELOCITIES. IT ASSUMES VAPOR GENERATION TO BE HEAT TRANSFER LIMITED ONLY, AND CALCULATES AXIAL DISTRIBUTION OF VELOCITY, VOID FRACTION, PRESSURE, COOLANT TEMPERATURE, AND FUEL TEMPERATURE. TRANSIENTS SIMULATING POWER EXCURSIONS, LOSS OF FLOW, LOSS OF PRESSURE AND CHANNEL PLUGGING CAN BE STUDIED.
4. METHOD OF SOLUTION - EACH TRANSIENT STARTS FROM SOME STEADY-STATE CONDITION DERIVED FROM INPUT PARAMETERS. ONE OF THESE SELECTED BY THE USER VARIES WITH TIME AND THE PROGRAM CALCULATES THE RESPONSE OF THE SYSTEM TO THIS DRIVING FUNCTION. THE HEAT BALANCE EQUATIONS ARE SOLVED BY USE OF FINITE DIFFERENCE TECHNIQUES AND THE MOMENTUM EQUATION IS DERIVED ASSUMING CONSTANT VAPOR DENSITY AND SATURATION TEMPERATURE, ELIMINATING PRESSURE FEEDBACK. NUMERICAL INSTABILITIES RESULTED WHEN ATTEMPTS WERE MADE TO REMOVE THESE LIMITATIONS. THE CODE IS SET UP TO PROVIDE USE OF A SMALLER TIME-STEP FOR THE MOMENTUM EQUATION THAN THAT USED FOR THE HEAT BALANCE AND MASS EQUATIONS IF REQUESTED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMUM OF - 100 SPATIAL NODES
6. TYPICAL RUNNING TIME - 2 TO 4 MINUTES ARE REQUIRED FOR AN 80-NODE PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS -
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
IBM7094 VERSION SUBMITTED JANUARY 1967.
10. REFERENCE - R. C. NOYES, J. G. MORGAN, AND H. H. CAPPEL, TRANS-FUGUE-1, A DIGITAL CODE FOR TRANSIENT TWO-PHASE FLOW AND HEAT TRANSFER, NAA-SR-11008, JULY 1965.
11. MACHINE REQUIREMENTS - 32K MEMORY
12. PROGRAMMING LANGUAGE USED - FORTRAN II
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD IBM FORTRAN MONITOR.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
IF AN SC-4020 GRAPHICAL DISPLAY DEVICE IS AVAILABLE, AICRT3 AND
THE NAA SC-4020 PACKAGE ARE AVAILABLE THROUGH -
UAIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA
15. NAME AND ESTABLISHMENT OF AUTHORS -
R. C. NOYES, J. G. MORGAN, AND H. H. CAPPEL
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1824 CARDS)
SAMPLE PROBLEM (31 CARDS)
REFERENCE REPORT
17. CATEGORY - G
KEYWORDS - HEAT TRANSFER, HYDRODYNAMICS, VAPORS, LIQUIDS, FLUID
FLOW, ACCIDENTS

1. NAME OR DESIGNATION OF PROGRAM - DTF-BURN
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7030
3. NATURE OF PHYSICAL PROBLEM SOLVED - DTF-BURN IS A ONE-DIMENSIONAL, MULTIGROUP BURNUP CODE BASED ON TRANSPORT THEORY. A DIFFERENT TYPE OF EIGENVALUE CALCULATION (MULTIPLICATION, PERIOD, NUCLIDE CONCENTRATION, ZONE THICKNESS, OR SYSTEM DIMENSION) CAN BE PERFORMED AT THE BEGINNING OF EACH OF A SPECIFIED SET OF TIME-STEPS. THIS FEATURE PERMITS THE SIMULATION, IN A SINGLE PROBLEM RUN, OF A SYSTEM IN WHICH VARIOUS CONTROL METHODS ARE USED AS A FUNCTION OF TIME. THE CONCENTRATION OF THE VARIOUS NUCLIDES IS PERMITTED TO VARY FROM REGION-TO-REGION OR POINT-BY-POINT. NUCLIDES CONSIDERED ARE U235, U236, U238, NP239, PU239, PU240, PU241, PU242, AND FP, A PSEUDO FISSION PRODUCT PAIR.
4. METHOD OF SOLUTION - REVISED SUBROUTINES FROM DTF-IV (ACC ABSTRACT 209) ARE USED IN THE SOLUTION OF THE NEUTRON FLUX DISTRIBUTION BY THE METHOD OF DISCRETE ORDINATES AT THE BEGINNING OF EACH TIME-STEP. THE NUCLIDE CONCENTRATION EQUATIONS ARE SOLVED IN THE SAME MANNER USED IN THE SIZZLE (ACC ABSTRACT 58) DIFFUSION BURNUP PROGRAM.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE PROGRAM EMPLOYS VARIABLE DIMENSIONING SO THAT A PROBLEM WITH ANY NUMBER OF NEUTRON ENERGY GROUPS AND SPATIAL INTERVALS MAY BE RUN, PROVIDED THE AVAILABLE CORE STORAGE IS NOT EXCEEDED. THE PROGRAM ITSELF REQUIRES ABOUT 12K WORDS.
6. TYPICAL RUNNING TIME - THE FOLLOWING DEPLETION PROBLEM RAN 28.32 MINUTES ON THE IBM7030 - 15 GROUP, 54, 50 SPATIAL INTERVALS, CYLINDRICAL GEOMETRY, VACUUM BOUNDARY CONDITION AT OUTER EDGE, CRITICAL POISON SEARCH AT BEGINNING OF EACH TIME-STEP, 5 BURNUP TIME INTERVALS, NUCLIDE CONCENTRATION SOLUTIONS POINT-BY-POINT. MORE TYPICAL DEPLETION PROBLEMS WITH 5 NEUTRON ENERGY GROUPS WOULD, THEREFORE, REQUIRE ABOUT 10 MINUTES OF RUNNING TIME.
7. UNUSUAL FEATURES OF THE PROGRAM - THE NUMBER OF TIME INTERVALS FOR BURNUP AND THE LENGTH OF EACH INTERVAL ARE SPECIFIED BY THE USER, SO THAT A DIFFERENT WIDTH CAN BE USED FOR EACH TIME-STEP. MICROSCOPIC CROSS SECTIONS USED IN THE SOLUTION OF THE NUCLIDE CONCENTRATION EQUATIONS CAN BE ENTERED AS A FUNCTION OF REGION. THE PROGRAM MAY BE SIMPLY MODIFIED FOR ANALYSES OF THE THORIUM CHAIN BY CHANGING VALUES OF THE DECAY CONSTANTS AND ATOMIC WEIGHTS WHICH ARE BUILT IN.
8. RELATED AND AUXILIARY PROGRAMS - DTF4
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
IBM7030 VERSION SUBMITTED FEBRUARY 1967.

10. REFERENCES - K. D. LATHROP, DTF-IV, A FORTRAN-IV PROGRAM FOR SOLVING THE MULTIGROUP TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING, LA-3373, JULY 15, 1965.
D. P. SATKUS AND H. P. FLATT, SIZZLE, NAA PROGRAM DESCRIPTION, FEBRUARY 1961.
J. J. PRABULOS, JR., DTF-BURN, A MULTIGROUP TRANSPORT THEORY BURNUP PROGRAM WRITTEN IN FORTRAN-IV, LA-3671, APRIL 28, 1967.
11. MACHINE REQUIREMENTS - NO SCRATCH TAPES OR DISKS ARE REQUIRED. A CLOCK IS USED TO COMPUTE EXECUTION TIME BUT IS NOT NECESSARY FOR THE RUNNING OF THE PROBLEMS.
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD FORTRAN MONITOR SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
J. J. PRABULOS, JR.
COMBUSTION ENGINEERING, INC.
NUCLEAR DIVISION
P. O. BOX 500
WINDSOR, CONNECTICUT 06095
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (7030-3516 CARDS)
SAMPLE PROBLEM (7030-59 CARDS)
REFERENCE REPORT, LA-3671
17. CATEGORY - 0
KEYWORDS - DEPLETION, TRANSPORT THEORY, 1-DIMENSIONAL, MULTIGROUP, SLABS, CYLINDERS, SPHERES, CONTROL SEARCHES

1. NAME OR DESIGNATION OF PROGRAM - CAESAR4/LIBLST
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360
3. NATURE OF PHYSICAL PROBLEM SOLVED - CAESAR4 SOLVES THE ONE-DIMENSIONAL, MULTIGROUP DIFFUSION EQUATIONS IN ANY OF THREE GEOMETRIES AND PROVIDES A WIDE CHOICE OF BOUNDARY CONDITIONS, CRITICALITY SEARCHES, EDITS AND OTHER AUXILIARY COMPUTATIONS.
4. METHOD OF SOLUTION - STANDARD FINITE-DIFFERENCE EQUATIONS ARE USED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
 - 20 REGIONS
 - 20 ELEMENTS IN LIBRARY
 - 12 ELEMENTS PER MATERIAL
 - 10 MATERIALS
 - 100 INTERVALS
 - 35 GROUPS
 - 10 DOWNSCATTER GROUPS
 - 20 GROUPS AND 15 ELEMENTS IN RESONANCE CROSS SECTION CALCULATION
6. TYPICAL RUNNING TIME - 1 TO 3 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
 - (A) NON-HOMOGENEOUS BOUNDARY CONDITIONS.
 - (B) FIXED SOURCE CALCULATION.
 - (C) CONVERGENCE ON SEARCH QUANTITY AS WELL AS ON EIGENVALUE OF SOURCE.
 - (D) TRANSVERSE BUCKLING CALCULATED OR INPUT AS CONSTANT, GROUP DEPENDENT, REGION DEPENDENT OR GROUP AND REGION DEPENDENT.
 - (E) OPTION TO USE SOURCE FROM PREVIOUS CASE TO START ITERATION.
 - (F) NUMEROUS PRINTING OPTIONS.
 - (G) DATA EDITS INCLUDE FLUX NORMALIZATION, PEAK-TO-AVERAGE POWER, MEDIAN FISSION ENERGY, MEDIAN FLUX ENERGY, MASS FISSION ELEMENTS, BREEDING RATIO BY REGION AND BY REACTOR, NEUTRON BALANCE AND REACTION RATES, MASS AND REACTION RATES BY ELEMENT, BY REGION AND REACTOR, INTEGRATED FLUXES, MEDIAN FISSION, ABSORPTION AND FLUX ENERGY BY MESH POINT, TOTAL BUCKLING PUNCHOUT FOR AILMOE.
 - (H) GROUP OR GROUP-REGION DEPENDENT FISSION SPECTRUM.
 - (I) ADJOINT FLUX CALCULATION.
 - (J) PERTURBATION CALCULATION USING THE PERT4 CODE.
 - (K) NINE DIFFERENT CRITICALITY SEARCHES.
 - (L) TRANSPORT CORRECTION TO DIFFUSION COEFFICIENT.
 - (M) MICROSCOPIC CROSS SECTION LIBRARY.
 - (N) INPUT OF MICROSCOPIC AND/OR MACROSCOPIC CROSS SECTIONS.
 - (O) PREPARATION OF HOMOGENIZED MATERIALS BY CELL CALCULATION.

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
 - (P) RESONANCE CROSS SECTION CALCULATION BY ARES2 OR BY TABLE INTERPOLATION IN CELL AND/OR REACTOR CALCULATION.
 - (Q) MATERIAL DEPENDENT CROSS SECTION TAPE PROVIDING A DIFFERENT MICROSCOPIC CROSS SECTION LIBRARY FOR EACH MATERIAL.
 - (R) MULTIPLE CASE FEATURE - ONLY CHANGES TO PREVIOUS CASE ARE REQUIRED. CELL CALCULATION CAN BE RERUN AS WELL AS REACTOR PROBLEMS.
8. RELATED AND AUXILIARY PROGRAMS -
 - (A) CAESAR4 IS BASED ON THE AIM, FOG (ACC ABSTRACT 28), FAIM (ACC ABSTRACT 120), PERT (ACC ABSTRACT 30) AND ARES2 (ACC ABSTRACT 89) PROGRAMS.
 - (B) THE MICROSCOPIC LIBRARY PROGRAM, LIBLST.
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
IBM360 VERSION SUBMITTED APRIL 1967.
10. REFERENCES - D. C. BALLER, CAESAR, CONVERSION TO SYSTEM/360, AI-66-MEMO-167, VOL. I AND FLOWCHARTS, VOL. II, DECEMBER 1966.
D. C. BALLER AND R. A. BLAINE, LIBLST, CONVERSION TO SYSTEM/360, AI-66-MEMO-166, VOL. I AND FLOWCHARTS, VOL. II, DECEMBER 1966.
D. C. BALLER AND R. A. BLAINE, LIBLST, A LIBRARY PREPARATION PROGRAM FOR THE CAESAR IV CODE, AI-66-MEMO-123, AUGUST 1966.
R. A. BLAINE, ATOMICS INTERNATIONAL ENVIRONMENT REPORT, MAY 1967.
11. MACHINE REQUIREMENTS - 256K BYTES
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (CAESAR4 9302 CARDS, LIBLST 290 CARDS)
OBJECT DECKS (CAESAR4 4506 CARDS, LIBLST 266 CARDS)
SAMPLE PROBLEM (CAESAR4 798 CARDS)
LIBRARY (LIBLST 407 CARDS)
REFERENCE REPORTS (FLOWCHART VOLUMES MAY BE REQUESTED ON A LOAN BASIS ONLY)

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17. CATEGORY - C
KEYWORDS - DIFFUSION EQUATIONS, 1-DIMENSIONAL, MULTIGROUP, SLABS,
CYLINDERS, SPHERES, CRITICALITY SEARCHES

1. NAME OR DESIGNATION OF PROGRAM - CLIP
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360
3. NATURE OF PHYSICAL PROBLEM SOLVED - CLIP IS THE CROSS SECTION LIBRARY PREPARATION AND MAINTENANCE PROGRAM FOR FORM AND THREDES.
4. METHOD OF SOLUTION -
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
6. TYPICAL RUNNING TIME - 1 TO 2 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM - CLIP -
 - (A) CREATES A FORM AND/OR THREDES LIBRARY FROM CARDS,
 - (B) UPDATES THE FORM OR THREDES LIBRARY,
 - (C) LISTS THE FORM OR THREDES LIBRARY,
 - (D) DUPLICATES THE FORM OR THREDES LIBRARY.THE TEMPEST CROSS SECTIONS (FOR THREDES) MAY COME FROM A DECIMAL OR HEXADECIMAL LIBRARY OR AN EXISTING THREDES LIBRARY. THE FORM CROSS SECTIONS MAY COME FROM CARDS OR AN EXISTING FORM OR THREDES LIBRARY. THE LIBRARIES MAY RESIDE ON DISK OR TAPE.
8. RELATED AND AUXILIARY PROGRAMS -
 - (A) FORM LIBRARY PROGRAMS
 - (B) TEMPEST (ACC ABSTRACT 50) LIBRARY PROGRAMS
 - (C) FORM (ACC ABSTRACT 51)
 - (D) THREDES (ACC ABSTRACT 273)
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
IBM360 VERSION FIRST SUBMITTED APRIL 1967.
10. REFERENCES - R. F. BERLAND AND R. A. BLAINE, CLIP, CONVERSION TO IBM SYSTEM/360, AI-66-MEMO-168, VOL. I AND FLOWCHARTS, VOL. II, DECEMBER 1966.
R. F. BERLAND AND R. A. BLAINE, CLIP, A PROGRAM TO CONSTRUCT, UPDATE AND LIST THE FORM OR THREDES MASTER DATA TAPE, AI-CE-MEMO-12, MARCH 1966.
R. A. BLAINE, ATOMICS INTERNATIONAL ENVIRONMENT REPORT, MAY 1967.
11. MACHINE REQUIREMENTS - 256K BYTES
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

REACTOR CODE ABSTRACT 271

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15. NAME AND ESTABLISHMENT OF AUTHOR -

R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANDGA PARK, CALIFORNIA

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECK (928 CARDS)
OBJECT DECK (980 CARDS)
TEMPEST AND FORM DECIMAL LIBRARIES (7077 CARDS)
REFERENCE REPORTS (FLOWCHART VOLUME MAY BE REQUESTED ON A LOAN
BASIS ONLY)

17. CATEGORY - M

KEYWORDS - CROSS SECTIONS, LIBRARIES, PREPARATION, MAINTENANCE,
RETRIEVAL, FORM CODES, THREDES CODES, DATA MANAGEMENT

1. NAME OR DESIGNATION OF PROGRAM - FIGRO
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - PHILCO 2000-212
3. NATURE OF PHYSICAL PROBLEM SOLVED - FIGRO CALCULATES THE ONE-DIMENSIONAL STEADY-STATE TEMPERATURE DISTRIBUTION AND TOTAL FUEL SWELLING FOR METAL-CLAD, AXISYMMETRIC, BULK-OXIDE CYLINDRICAL FUEL ELEMENTS. THE FUEL PELLET MAY BE SOLID, ANNULAR, OR CONTAIN TWO RADIAL ZONES. OXIDE FUEL THERMAL CONDUCTIVITY IS A FUNCTION OF TEMPERATURE, DEPLETION, AND POROSITY. FUEL SWELLING IS A FUNCTION OF TEMPERATURE, DEPLETION, INTERNAL HYDROSTATIC PRESSURE, AND FISSI-ONING RATE. EITHER THE CLAD SURFACE FLUX OR THE TEMPERATURE AT THE INSIDE RADIUS OF THE FUEL MAY BE SPECIFIED AS A BOUNDARY CONDITION FOR THE HEAT CONDUCTION EQUATION.
4. METHOD OF SOLUTION - FUEL SWELLING IS COMPUTED FROM EITHER THE GREENWOOD-SPEIGHT MODEL OR THE ASSUMPTION OF FIXED BUBBLE NUMBER AND SPACING. THERMAL CONDUCTIVITY OF THE CLADDING IS ASSUMED INDEPENDENT OF TEMPERATURE, THAT OF FUEL CALCULATED FROM A FUNCTIONAL RELATIONSHIP INVOLVING TEMPERATURE, DEPLETION, POROSITY, AND MATERIAL PROPERTIES. HEAT TRANSFER AT GAPS AND INTERFACES IS DESCRIBED BY HEAT TRANSFER COEFFICIENTS AND HEAT GENERATION IS COMPUTED FROM USER SPECIFIED FRACTIONS OF THE TOTAL ROD HEAT GENERATION WITH THE ROD ASSUMED UNIFORM AXIALLY AND AXIAL HEAT TRANSFER NEGLECTED. THE VOLUMETRIC HEAT GENERATION RATE OF EACH FUEL ZONE CAN BE DESCRIBED BY EITHER A BESSEL FUNCTION SHAPE $I_0(KR)$ OR A PIECEWISE LINEAR SHAPE $F(R)$. THE POWER SHAPE IS NORMALIZED TO ACHIEVE THE DESIRED SURFACE FLUX OR TOTAL HEAT GENERATION, AND THE TEMPERATURE DISTRIBUTION IS FOUND BY SOLVING THE HEAT CONDUCTION EQUATION. THE HEAT CONDUCTION AND FUEL VOLUME SWELLING EQUATIONS ARE SOLVED SIMULTANEOUSLY UNTIL TEMPERATURE CONVERGENCE IS ACHIEVED. A USER OPTION DETERMINES USE OF POROSITY AND/OR DIMENSION CHANGES TO ACCOMMODATE FUEL SWELLING.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - EACH FUEL ZONE MAY BE SUBDIVIDED INTO A MAXIMUM OF 100 CONCENTRIC EQUAL-THICKNESS ANNULI FOR THE CALCULATION OF TEMPERATURE AND FUEL GROWTH.
6. TYPICAL RUNNING TIME - THE ESTIMATED RUNNING TIME ON THE PHILCO 2000-212 IS ONE SECOND FOR A SPECIFIED CLAD-SURFACE FLUX PROBLEM AND 10 SECONDS FOR A SPECIFIED INTERNAL FUEL TEMPERATURE PROBLEM.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - IN FUEL ELEMENT DESIGN STUDIES FIGRO IS USED TO SET BASIC TEMPERATURE PARAMETERS AND AS A SURVEY TOOL FOR COMPARING DEPLETION CAPABILITIES WITH CYGRO (ACC ABSTRACT 266) USED TO CONFIRM THE ANALYSIS OF FUEL ELEMENT BEHAVIOR.
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
PHILCO 2000 VERSION SUBMITTED MARCH 1967.

10. REFERENCE - I. GOLDBERG, L. L. LYNN, AND C. D. SPAR, FIGRO - FORTRAN IV DIGITAL COMPUTER PROGRAM FOR THE ANALYSIS OF FUEL SWELLING AND CALCULATION OF TEMPERATURE IN BULK-OXIDE CYLINDRICAL FUEL ELEMENTS, WAPD-TM-618, DECEMBER 1966.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - BKS8.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - FIGRO USES THE INPF PACKAGE AS DESCRIBED IN THE REPORT BY O. J. MARLOWE, BETTIS FORTRAN PROGRAMMING AUXILIARY SUBROUTINES, WAPD-TM-365, FEBRUARY 1963. DOMESTIC USERS MAY OBTAIN THIS PACKAGE THROUGH -
TUG EXECUTIVE SECRETARY
3900 WELSH ROAD
WILLOW GROVE, PENNSYLVANIA
15. NAME AND ESTABLISHMENT OF AUTHOR -
L. L. LYNN
WESTINGHOUSE ELECTRIC CORPORATION
BETTIS ATOMIC POWER LABORATORY
BOX 79
WEST MIFFLIN, PENNSYLVANIA 15122
16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1950 CARDS)
SAMPLE PROBLEMS (57 CARDS)
REFERENCE REPORT
17. CATEGORY - H
KEYWORDS - TEMPERATURE DISTRIBUTION, FUEL ELEMENTS, CYLINDERS, EXPANSION, DEPLETION, PRESSURE, HEAT TRANSFER, ANNULAR SPACE

1. NAME OR DESIGNATION OF PROGRAM - THREDES
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360
3. NATURE OF PHYSICAL PROBLEM SOLVED - THREDES IS A SCIENTIFIC APPLICATIONS PROGRAMMING SYSTEM. INCORPORATED IN THIS SYSTEM ARE THE NECESSARY MODULES TO PERFORM PARAMETRIC DESIGN STUDIES OF THERMAL REACTORS INCLUDING THE THERMAL CELL HOMOGENIZATION (BAM - ACC ABSTRACT 108), THE FAST SPECTRUM CALCULATION (FORM - ACC ABSTRACT 51), REACTOR DIFFUSION THEORY (FOG - ACC ABSTRACT 28), AND ZERO-DIMENSIONAL BURNUP (KINDLE) CALCULATIONS. THESE MODULES CAN BE USED IN CONJUNCTION WITH ONE ANOTHER OR INDIVIDUALLY.
4. METHOD OF SOLUTION -
 - BAM - ASSUMES SEPARABILITY OF SPACE AND ENERGY - ITERATES BETWEEN TEMPEST-II TO OBTAIN WIGNER-WILKINS, WILKINS OR MAXWELLIAN AVERAGED CROSS SECTIONS AND THE CYLINDRICAL CELL CODE TO OBTAIN THERMAL DISADVANTAGE FACTORS. PHYSICS DATA IS MADE AVAILABLE FOR USE IN FORM AND FOG OR KINDLE.
 - FORM - SOLVES THE FOURIER TRANSFORM OF THE BOLTZMANN EQUATION FOR THE FAST SPECTRUM AND PREPARES PHYSICS DATA FOR USE IN FOG OR KINDLE.
 - FOG - SOLVES THE 4 GROUP DIFFUSION THEORY APPROXIMATION TO THE ONE-DIMENSIONAL TRANSPORT EQUATION USING A STANDARD FINITE-DIFFERENCE SCHEME.
 - KINDLE - PERFORMS AN ANALYTIC SOLUTION OF ISOTOPE EQUATIONS AND REACTIVITY EQUATIONS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
 - BAM -
 - 10 REGIONS
 - 100 SPACE POINTS
 - 20 ISOTOPES PER REGION
 - FORM -
 - 18 DIFFERENT ISOTOPES
 - FOG -
 - 4 GROUPS
 - 238 SPACE POINTS
 - KINDLE -
 - 2 GROUPS
6. TYPICAL RUNNING TIME - 5 TO 10 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
 - (A) EMPHASIS ON MULTIPLE CASES WITH ONLY CHANGES SPECIFIED TO ALLOW RAPID PARAMETER SURVEYS.
 - (B) ABILITY TO USE MODULES INDIVIDUALLY.
 - (C) USE OF MODULES AS AN INTEGRATED SYSTEM TO PREPARE DATA FOR ONE ANOTHER.

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7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
(D) ABILITY TO PERFORM ENTIRE REACTOR DESIGN CALCULATIONS IN ONE COMPUTER RUN.
8. RELATED AND AUXILIARY PROGRAMS - CLIP (ACC ABSTRACT 271) COMBINES THE LIBRARY PREPARATION PROGRAMS FOR FORM AND TEMPEST (ACC ABSTRACT 50) AND IS USED TO GENERATE, PRINT AND/OR MAINTAIN TEMPEST, FORM AND/OR THREDES LIBRARIES ON TAPE OR DISK.
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
IBM360 VERSION SUBMITTED APRIL 1967.
10. REFERENCES - R. A. BLAINE, THREDES, CONVERSION TO IBM SYSTEM/360, AI-66-MEMO-169, VOL. I AND FLOWCHARTS, VOL. II, DECEMBER 1966.
R. A. BLAINE, THREDES, ATOMICS INTERNATIONAL THERMAL REACTOR DESIGN SYSTEM, AI-CE-MEMO-11, MARCH 1966.
R. A. BLAINE, ATOMICS INTERNATIONAL ENVIRONMENT REPORT, MAY 1967.
11. MACHINE REQUIREMENTS - 256K BYTES
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - IF AN SC-4020 GRAPHICAL DISPLAY DEVICE IS AVAILABLE, AICRT4 AND THE NAA SC-4020 SUBROUTINE PACKAGE ARE AVAILABLE THROUGH -
UAIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. A. BLAINE
SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (7973 CARDS)
OBJECT DECK (5527 CARDS)
SAMPLE PROBLEM (252 CARDS)
REFERENCE REPORTS (FLOWCHART VOLUME MAY BE REQUESTED ON A LOAN BASIS ONLY)
17. CATEGORY - K
KEYWORDS - REACTORS, DESIGN, 1-DIMENSIONAL, CELL CALCULATION, FAST SPECTRA, DIFFUSION EQUATIONS, DEPLETION, BAM CODES, FORM CODES, FOG CODES, KINDLE CODES

1. NAME OR DESIGNATION OF PROGRAM - WIGL2
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600, UNIVAC1108
3. NATURE OF PHYSICAL PROBLEM SOLVED - WIGL2 IS A ONE-DIMENSIONAL TWO-GROUP SPACE-TIME DIFFUSION THEORY PROGRAM WITH ZERO, ONE, OR SIX DELAYED NEUTRON GROUPS. THE PROGRAM WILL TREAT SLAB, CYLINDRICAL, AND SPHERICAL GEOMETRIES AND INCLUDES NON-BOILING HEAT TRANSFER. IT ACCOUNTS FOR XENON FEEDBACK AND FEEDBACK EFFECTS DUE TO FUEL AND COOLANT TEMPERATURE. CONTROL ROD MOTION AND CONTROL SYSTEM FEEDBACK BASED ON TOTAL CORE POWER OR OUTLET COOLANT TEMPERATURE CAN BE SIMULATED. TRANSIENTS MAY BE EXCITED BY PRESCRIBED CHANGES IN INLET COOLANT TEMPERATURE, COOLANT FLOW RATE, OR ROD POSITION.
4. METHOD OF SOLUTION - THE NEUTRON EQUATIONS ALONG WITH THE VARIOUS FEEDBACK PROCESSES FORM A NONLINEAR SYSTEM OF EQUATIONS. THE SOLUTION IS OBTAINED BY COMPUTING THE CHANGES IN NUCLEAR PARAMETERS DURING A GIVEN TIME-STEP BY USING THE NEUTRON FLUXES AT THE BEGINNING OF THE TIME-STEP. THE TIME-DIFFERENCE FORM OF THE DIFFUSION EQUATIONS IS OBTAINED BY REPLACING CONTINUOUS TIME BY A SEQUENCE OF TIMES AND INTRODUCING A SET OF INTERNALLY COMPUTED TIME DEPENDENT PARAMETERS (THETAS) TO INCREASE THE STABILITY AND ACCURACY OF THE NUMERICAL METHOD. THE THETA-METHOD IS DISCUSSED IN DETAIL IN REFERENCE 1. AT EACH TIME-STEP THE SPATIAL EQUATIONS ARE SOLVED BY A SIMULTANEOUS INVERSION OF THE TWO-GROUP OPERATOR. THUS, NO SPATIAL ITERATION IS REQUIRED. THE COEFFICIENTS OF THESE EQUATIONS ARE FUNCTIONS OF LOCAL COOLANT TEMPERATURE, FUEL METAL TEMPERATURE, AND CONTROL MOTION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - FOR THE 6600 NO RESTRICTIONS ARE PLACED ON SINGLE PARAMETERS RELATED TO PROBLEM SIZE. THE TOTAL AMOUNT OF STORAGE SET ASIDE FOR ALL PARAMETERS IS 14,000 MEMORY LOCATIONS. THIS ALLOWS THE USER TO DECIDE WHICH AREA REQUIRES A MORE DETAILED REPRESENTATION. FOR THE 1108 -
LET I = NUMBER OF DELAY GROUPS
 N = NUMBER OF COMPOSITIONS
 NDT = NUMBER OF CHANGES IN TIME-STEP SIZE
 P = NUMBER OF SPATIAL POINTS
 K = NUMBER OF THERMAL-HYDRAULIC REGIONS
 R = NUMBER OF NUCLEAR REGIONS
THEN (3*NDT + (3+I) * R + 40*N + 6*K + (8+I)*P +1) LESS THAN OR
 EQUAL TO 12,000
AND (26*P + R + 16*K + 12) LESS THAN OR EQUAL TO 16,000
6. TYPICAL RUNNING TIME - ON THE 6600 A PROBLEM WITH 50 SPATIAL POINTS, 20 THERMAL-HYDRAULIC REGIONS, AND 20 NUCLEAR REGIONS WOULD RUN LESS THAN ONE SECOND PER TIME-STEP. THE TIME INCREASES WITH AN INCREASE IN THESE PARAMETERS. THE AMOUNT OF PRINTING REQUESTED ALSO EFFECTS RUNNING TIME. ON THE 1108 A PROBLEM WITH 50 SPATIAL POINTS AND ONE DELAYED NEUTRON GROUP REQUIRES 0.10 SECOND PER

15. NAME AND ESTABLISHMENT OF AUTHORS (CONTINUED)
1108 STEPHEN R. JOHNSON
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112
16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL (2 TAPES (6600 VERSION), 1 TAPE
(1108 VERSION))
SOURCE DECKS (6600-4483 CARDS, 1108-4041 CARDS)
SAMPLE PROBLEMS (6600-32 CARDS, 1108-50 CARDS)
BETTIS ENVIRONMENTAL ROUTINES (21,125 CARDS - 6600 VERSION)
REFERENCE REPORTS AND ADDENDUM
17. CATEGORY - F
KEYWORDS - SPACE-TIME, 1-DIMENSIONAL, DIFFUSION EQUATIONS, 2-
GROUP, SLABS, CYLINDERS, SPHERES, HEAT TRANSFER, XENON,
TEMPERATURE, CONTROL, FEEDBACK

REACTOR CODE ABSTRACT 275

12/67

1. NAME OR DESIGNATION OF PROGRAM - PDQ7
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600
3. NATURE OF PHYSICAL PROBLEM SOLVED - PDQ7 SOLVES FEW-GROUP NEUTRON DIFFUSION-DEPLETION PROBLEMS IN ONE, TWO, AND THREE DIMENSIONS. ADJOINT SOLUTIONS ARE ALSO AVAILABLE AND TWO OVERLAPPING THERMAL GROUPS MAY BE USED IN ONE AND TWO-DIMENSIONAL PROBLEMS. EITHER POINTWISE OR REGIONWISE DEPLETION MAY BE PERFORMED USING THE HARMONY DEPLETION SYSTEM. THE GEOMETRY MAY BE RECTANGULAR, CYLINDRICAL, OR SPHERICAL IN ONE DIMENSION, RECTANGULAR, CYLINDRICAL, OR HEXAGONAL IN TWO DIMENSIONS, AND RECTANGULAR OR HEXAGONAL IN THREE DIMENSIONS. ALL GEOMETRIES PROVIDE FOR VARIABLE MESH SPACING IN ALL DIMENSIONS. ZERO FLUX, ZERO CURRENT, AND ROTATIONAL SYMMETRY BOUNDARY CONDITIONS ARE AVAILABLE, AND BOUNDARY VALUE PROBLEMS MAY BE SOLVED BY SPECIFYING THE FLUX VALUES ON ONE OR MORE BOUNDARIES.
4. METHOD OF SOLUTION - DIFFERENCE EQUATIONS ARE OBTAINED AT EACH POINT BY INTEGRATING THE DIFFERENTIAL EQUATIONS OVER AN APPROPRIATE MESH ELEMENT. THE RESULTING EQUATIONS ARE THREE-POINT, FIVE-POINT, AND SEVEN-POINT IN ONE, TWO, AND THREE DIMENSIONS EXCEPT FOR HEXAGONAL GEOMETRY, WHERE THE NUMBER OF POINTS IS INCREASED BY TWO. THE GROUP EQUATIONS ARE SOLVED USING A SINGLE-LINE CYCLIC CHEBYSHEV SEMI-ITERATIVE TECHNIQUE AND THE SOURCE ITERATIONS ARE ACCELERATED BY A PROCEDURE BASED ON CHEBYSHEV POLYNOMIALS.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE TOTAL NUMBER OF GROUPS IS LIMITED TO 5. THE PRODUCT OF GROUPS AND POINTS CANNOT EXCEED 300,000 AND THE PLANE SIZE IN THREE-DIMENSIONAL PROBLEMS IS RESTRICTED TO 8000 POINTS.
6. TYPICAL RUNNING TIME - THE RUNNING TIME IN HOURS MAY BE ESTIMATED BY DIVIDING THE PRODUCT OF GROUPS AND POINTS BY 150000. THE ACTUAL TIME MAY VARY WIDELY FROM THIS ESTIMATE DUE EITHER TO SPECIAL CONVERGENCE DIFFICULTIES OR TO THE COMPLEXITY OF THE DEPLETION FORMULATION.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - HARMONY TABLE SETS MAY BE INPUT ON CARDS OR MAY BE OBTAINED FROM A FILE GENERATED BY A CROSS SECTION PROGRAM. ON REQUEST, PDQ7 WILL PREPARE OUTPUT FILES CONTAINING FLUX, CONCENTRATION, POWER, INTEGRAL, AND GEOMETRY DATA, AND THESE FILES MAY BE FURTHER PROCESSED IN AUXILIARY PROGRAMS.
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
CDC6600 VERSION SUBMITTED MAY 1967.
10. REFERENCES - W. R. CADWELL, PDQ-7 REFERENCE MANUAL, WAPD-TM-678, JANUARY 1967.

10. REFERENCES (CONTINUED)

R. J. BREEN, D. J. MARLOWE, AND C. J. PFEIFER,
HARMONY - SYSTEM FOR NUCLEAR REACTOR DEPLETION COMPUTATION,
WAPD-TM-478, JANUARY 1965.

C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS
ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

11. MACHINE REQUIREMENTS - THE CENTRAL MEMORY SIZE MUST BE AT LEAST
64K AND THERE MUST BE FOUR NON-SYSTEM DISKS, EACH ON ITS OWN CHAN-
NEL.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
SCOPE 2.0.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
THE REQUIRED SOFTWARE ENVIRONMENT IS DESCRIBED IN REFERENCE 3.
IT INCLUDES ROUTINES FOR PROGRAM LOADING, INPUT CONVERSION AND
PROCESSING, STORAGE AND RETRIEVAL OF PERMANENT FILES, SCRATCH
INPUT/OUTPUT, AND STORAGE ALLOCATION. CALL REMARK IN SUBROUTINE
CASENN REFERS TO A 6600 SYSTEM ROUTINE FOR DISPLAY OF MESSAGES ON
THE OPERATOR SCOPE. CALL TICK REFERS TO A 6600 SYSTEM ROUTINE FOR
LOGGING JOB TIME USED. SUBSTITUTE ROUTINES WILL BE REQUIRED FOR
USE OF THIS PROGRAM ON OTHER MACHINES.

15. NAME AND ESTABLISHMENT OF AUTHORS -

W. R. CADWELL AND C. J. PFEIFER
BETTIS ATOMIC POWER LABORATORY
WESTINGHOUSE ELECTRIC CORPORATION
P. O. BOX 79
WEST MIFFLIN, PENNSYLVANIA 15122

16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION

MAGNETIC TAPE TRANSMITTAL (3 TAPES)
SOURCE DECK (27814 CARDS)
SAMPLE PROBLEMS (71 CARDS)
BETTIS ENVIRONMENTAL ROUTINES (21,125 CARDS)
REFERENCE REPORTS, WAPD-TM-678 AND WAPD-TM-668

17. CATEGORY - D

KEYWORDS - DEPLETION, DIFFUSION EQUATIONS, 1-DIMENSIONAL, SLABS,
CYLINDERS, SPHERES, 2-DIMENSIONAL, HEXAGONAL, X-Y, R-Z,
3-DIMENSIONAL, X-Y-Z, FEW-GROUP, HARMONY CODES

REACTOR CODE ABSTRACT 276

12/67

1. NAME OR DESIGNATION OF PROGRAM - AVOID
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE625
3. NATURE OF PHYSICAL PROBLEM SOLVED - AVOID COMPUTES THE EQUIVALENT DIFFUSION COEFFICIENT AND LOSS CROSS SECTION OF AN ANNULAR VOID IN A CYLINDRICAL REACTOR AND THE RADIAL FLUX DISTRIBUTION IN THE VOID.
4. METHOD OF SOLUTION - GIVEN THE INNER AND OUTER RADII OF A VOID ANNULUS, THE NEUTRON FLUX RATIO ACROSS THE ANNULUS, AND THE EFFECTIVE ESCAPE PROBABILITIES FOR NEUTRONS ENTERING THE VOID, THE CODE COMPUTES THE EFFECTIVE DIFFUSION COEFFICIENT AND LOSS CROSS SECTION WHICH ARE CONSISTENT WITH A P1 FLUX EXPANSION IN THE VOID.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMUM OF - 100 EQUAL INTERVALS AT WHICH THE GAP FLUX IS CALCULATED
6. TYPICAL RUNNING TIME - THE EIGHT SAMPLE PROBLEMS USED 5 SECONDS OF PROCESSOR TIME ON THE GE625.
7. UNUSUAL FEATURES OF THE PROGRAM - A FORTRAN IV BESSEL FUNCTION SUBROUTINE FOR I0, I1, K0, K1 IS INCLUDED.
8. RELATED AND AUXILIARY PROGRAMS - AVOID CAN BE USED AS A SUBROUTINE OF ONE-DIMENSIONAL DIFFUSION OR TRANSPORT CODES FOR RADIAL CALCULATIONS, THUS ELIMINATING THE NEED FOR A PRIOR KNOWLEDGE OF THE FLUX RATIO ACROSS THE GAP.
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
GE625 VERSION SUBMITTED MAY 1967.
10. REFERENCE - W. B. HENDERSON, PROGRAM AVOID, NMP-838, A FORTRAN IV PROGRAM FOR EVALUATING THE EQUIVALENT DIFFUSION COEFFICIENT AND LOSS CROSS SECTION OF AN ANNULAR VOID IN CYLINDRICAL REACTORS, GEMP-424, APRIL 15, 1966.
11. MACHINE REQUIREMENTS - 12K CORE MEMORY EXCLUSIVE OF SYSTEM USE
12. PROGRAMMING LANGUAGE USED - FORTRAN IV
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GECOS.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE MAIN PROGRAM USES 1170 (OCTAL) LOCATIONS PLUS 1454 (OCTAL) LOCATIONS OF COMMON STORAGE. THE BESSEL SUBROUTINE USES 374 (OCTAL) LOCATIONS. THE PROGRAM SHOULD COMPILE ON ANY SYSTEM HAVING THE NAMELIST FEATURE.

15. NAME AND ESTABLISHMENT OF AUTHOR -
W. B. HENDERSON
NUCLEAR MATERIALS AND PROPULSION OPERATION
GENERAL ELECTRIC COMPANY
CINCINNATI, OHIO 45215
16. MATERIAL AVAILABLE -
SOURCE DECK (625-190 CARDS)
SAMPLE PROBLEM (625-12 CARDS)
REFERENCE REPORT
17. CATEGORY - B
KEYWORDS - ANNULAR SPACE, CROSS SECTIONS, FLUX DISTRIBUTION,
CYLINDERS

REACTOR CODE ABSTRACT 277

12/67

1. NAME OR DESIGNATION OF PROGRAM - HAMMER/LITHE/HELP/LIBCON
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090,360
3. NATURE OF PHYSICAL PROBLEM SOLVED - HAMMER PERFORMS INFINITE LATTICE, ONE-DIMENSIONAL CELL MULTIGROUP CALCULATIONS, FOLLOWED (OPTIONALLY) BY ONE-DIMENSIONAL, FEW-GROUP, MULTIREGION REACTOR CALCULATIONS WITH NEUTRON BALANCE EDITS.
4. METHOD OF SOLUTION - INFINITE LATTICE PARAMETERS ARE CALCULATED BY MEANS OF MULTIGROUP TRANSPORT THEORY, COMPOSITE REACTOR PARAMETERS BY FEW-GROUP DIFFUSION THEORY.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
 - CELL CALCULATIONS - MAXIMA OF
 - 30 THERMAL GROUPS
 - 54 EPITHERMAL GROUPS
 - 20 SPACE POINTS
 - 20 REGIONS
 - 18 ISOTOPES
 - 10 MIXTURES
 - 3 THERMAL UPSCATTERING MIXTURES
 - 200 RESONANCES PER GROUP
 - NO OVERLAP OR INTERFERENCE
 - SINGLE LEVEL ONLY
 - REACTOR CALCULATIONS - MAXIMA OF
 - 40 REGIONS
 - 40 MIXTURES
 - 250 SPACE POINTS
 - 4 GROUPS
6. TYPICAL RUNNING TIME - 3 TO 5 MINUTES ARE REQUIRED ON THE 7094-II.
7. UNUSUAL FEATURES OF THE PROGRAM - HAMMER COMBINES THERMOS (ACC ABSTRACT 184), MUFT, ZUT (ACC ABSTRACT 41), TUZ (ACC ABSTRACT 42), FOG (ACC ABSTRACT 28), PLUS THERMAL FOURIER TRANSFORM, EPITHERMAL INTEGRAL TRANSPORT SPACE-DEPENDENT GROUP FLUXES, AND NEUTRON BALANCE EDITS FROM A SINGLE SET OF INPUT DATA AS WELL AS A LIBRARY OF CELL RESULTS, COMPATIBLE REACTOR/EXPONENTIAL ASSEMBLY CRITICALITY SEARCHES FROM THE LIBRARY.
8. RELATED AND AUXILIARY PROGRAMS - LITHE PREPARES A THERMAL LIBRARY FOR THE HAMMER VERSION OF THERMOS AND INCLUDES EPITHERMAL SCATTERING SOURCES. HELP PREPARES AN EPITHERMAL LIBRARY FOR THE HAMMER VERSIONS OF MUFT, ZUT, TUZ, AND CELL SPACE-DEPENDENT CALCULATIONS. IT ACCEPTS SLIGHTLY MODIFIED MUFT LIBRARIES PLUS RESONANCE PARAMETERS, EITHER PROBABILITY MATRIX OR INELASTIC CROSS SECTIONS. LIBCON IS USED TO CONVERT CROSS SECTION DATA CARDS IN THE MUFT/FORM EXCESS 50 NOTATION TO THE HELP INPUT FORMAT.

9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
IBM7090 VERSION SUBMITTED JULY 1967.
IBM360 VERSION SUBMITTED JULY 1967.
10. REFERENCE - J. E. SUICH AND H. C. HONECK, THE HAMMER SYSTEM, DP-1064, JANUARY 1967.
11. MACHINE REQUIREMENTS - 32K MEMORY AND 10 TAPE UNITS (7090), 512K BYTES AND 10 SEQUENTIAL DATA SETS (360)
12. PROGRAMMING LANGUAGES USED - FORTRAN II (IBM7090) AND FORTRAN IV (IBM360)
13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN MONITOR SYSTEM (7090), OS360 (360).
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHOR -
J. E. SUICH
E. I. DUPONT DE NEMOURS AND CO., INC.
SAVANNAH RIVER LABORATORY
AIKEN, SOUTH CAROLINA 29801
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (LITHE 360-430 CARDS, 7090-426 CARDS, HELP 360-583 CARDS, 7090-557 CARDS, HAMMER 360-12920 CARDS 7090-12520 CARDS, LIBCON 7090-253 CARDS)
SAMPLE PROBLEMS (HAMMER 360-55 CARDS, 7090-12 CARDS)
LIBRARIES (LITHE 360-3455 CARDS, 7090-3444 CARDS, HELP 360-3817 CARDS, 7090-3807 CARDS)
REFERENCE REPORT
17. CATEGORY - B
KEYWORDS - CELL CALCULATION, 1-DIMENSIONAL, THERMAL, EPITHERMAL, GROUP CONSTANTS, FLUX DISTRIBUTION, LITHE CODES, HELP CODES, LIBCON CODES

REACTOR CODE ABSTRACT 278

12/67

1. NAME OR DESIGNATION OF PROGRAM - WATER-HAMMER
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600, IBM360
3. NATURE OF PHYSICAL PROBLEM SOLVED - THE PROGRAM ANALYZES HYDRAULIC TRANSIENTS IMPOSED BY THE SUDDEN DISCHARGE OF LIQUID FROM THE PRIMARY COOLANT LOOP, BEFORE ANY GENERATION OF VAPOR HAS TAKEN PLACE. EFFECTS OF HYDRAULIC LOSSES ARE NEGLECTED. THE LOOP PRESSURIZER IS ASSUMED TO REMAIN CONSTANT AT INITIAL PRESSURE AND THE PRESENCE OF A PUMP IS IGNORED. IT WAS DESIGNED FOR THE EARLY BLOWDOWN ANALYSIS FOR LOFT.
4. METHOD OF SOLUTION - THE UNSTEADY FLUID MOTION IS DESCRIBED BY THE SET OF MASS, MOMENTUM, AND ENERGY CONSERVATION LAWS, THE EQUATION OF STATE FOR THE FLUID, THE HEAT TRANSFER EQUATIONS FOR THE PIPE WALL AND THE INITIAL AND BOUNDARY CONDITIONS FOR ALL DEPENDENT VARIABLES. THE WELL-KNOWN WATER-HAMMER EQUATIONS FOR THE LIQUID-FILLED PIPES ARE THEN EVALUATED BY USE OF THE WAVE SUPERPOSITION METHOD. THE FRICTIONLESS CASE IS CONSIDERED.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE LOOP CAN CONSIST OF UP TO 100 JUNCTIONS OF WHICH THREE ARE OF A SPECIAL KIND -
 - (1) EXIT JUNCTION
 - (2) PRESSURIZER JUNCTION
 - (3) CHECK VALVE JUNCTION
6. TYPICAL RUNNING TIME - 3 MINUTES ARE REQUIRED.
7. UNUSUAL FEATURES OF THE PROGRAM -
8. RELATED AND AUXILIARY PROGRAMS - WATER-HAMMER APPLIES ONLY TO THE LIQUID-FILLED COOLANT LOOP LIMITING ITS APPLICATION TO THE SUBCOOLED PORTION OF BLOWDOWN. TO PROVIDE THE ANALYSES AS BLOWDOWN CHANGES FROM SUBCOOLED TO SATURATED TYPE, THE RESULTS OF THE WATER-HAMMER AND SATURATED-BLOWDOWN (ACC ABSTRACT 200) PROGRAMS MUST BE JUDICIOUSLY CONNECTED.
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
CDC3600 VERSION SUBMITTED MAY 1967.
IBM360 VERSION SUBMITTED JULY 1967.
10. REFERENCE - STANISLAV FABIC, EARLY BLOWDOWN (WATER-HAMMER) ANALYSIS FOR LOSS-OF-FLUID TEST FACILITY, KAISER ENGINEERS, 65-2B-RA, JUNE 1965 REVISED APRIL 1967.
11. MACHINE REQUIREMENTS -
12. PROGRAMMING LANGUAGES USED - FORTRAN 63 (CDC3600) AND FORTRAN H (360)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
SCOPE (3600) AND DS/360.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
15. NAME AND ESTABLISHMENT OF AUTHORS -
3600 S. FABIC
KAISER ENGINEERS
KAISER INDUSTRIES CORPORATION
KAISER CENTER
300 LAKESIDE DRIVE
OAKLAND, CALIFORNIA 94604
- 360 M. DUSZYNSKI
UNIVERSITY OF GEORGIA COMPUTER CENTER
ATHENS, GEORGIA 30601
16. MATERIAL AVAILABLE -
SOURCE DECKS (3600-453 CARDS, 360-471 CARDS)
BINARY DECK (3600-151 CARDS)
SAMPLE PROBLEMS (3600-14 CARDS, 360-74 CARDS)
REFERENCE REPORT
17. CATEGORY - G
KEYWORDS - ACCIDENTS, COOLANTS, BLOWDOWN, LIQUIDS, LOFT REACTORS,
HEAT TRANSFER

REACTOR CODE ABSTRACT 279

12/67

1. NAME OR DESIGNATION OF PROGRAM - LEOPARD/AITP1/AITP3/SPOTS
2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090
3. NATURE OF PHYSICAL PROBLEM SOLVED - LEOPARD IS A UNIT CELL HOMOGENIZATION AND SPECTRUM GENERATION (MUFT-SOFOCATE) PROGRAM WITH A FUEL DEPLETION OPTION.
4. METHOD OF SOLUTION - THE MUFT-SOFOCATE HOMOGENEOUS MEDIUM SPECTRUM ANALYSES WITH HETEROGENEOUS CORRECTIONS ARE USED. THE MONDENER-GETIC AMOUYAL-BENDIST THERMAL DISADVANTAGE FACTOR IS APPLIED AT EACH OF 172 SOFOCATE ENERGY LEVELS UP TO 0.625 EV. THE U238 RESONANCE INTEGRAL IS FORCED TO AGREE WITH A GENERALIZED HELLSTRAND CORRELATION.
5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - LEOPARD WORKS WITH NUCLIDES COMMONLY USED IN WATER REACTORS. THORIUM AND U-238 FUEL CHAINS ARE ALLOWED.
6. TYPICAL RUNNING TIME - RUNNING TIME IS ABOUT ONE MINUTE PER CASE ON AN IBM7090.
7. UNUSUAL FEATURES OF THE PROGRAM - LEOPARD IS AN ENGINEERING DESIGN CODE FEATURING SIMPLE INPUT REQUIREMENTS OF PHYSICAL DATA. EDITS ARE EXTENSIVE AND INCLUDE PUNCHED DATA DECKS FOR OTHER NUCLEAR CODES. A COMPLETE SUBROUTINE PACKAGE IS PROVIDED TO BUFFER NORMAL FORTRAN II PROGRAMMING.
8. RELATED AND AUXILIARY PROGRAMS -
 AITP1 (MODIFIED) CONVERTS CARD DATA TO A FORM-TYPE LIBRARY TAPE.
 AITP3 (MODIFIED) EDITS THE AITP1 TAPE.
 SPOTS CONVERTS THE AITP1 TAPE AND A TEMPEST DECIMAL DATA DECK TO A LEOPARD LIBRARY TAPE.
9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
 IBM7090 VERSION SUBMITTED MAY 1967.
10. REFERENCES - L. E. STRAWBRIDGE AND R. F. BARRY, CRITICALITY CALCULATIONS FOR UNIFORM WATER-MODERATED LATTICES, NUCLEAR SCIENCE AND ENGINEERING 23, PP. 58-73, 1965.
 R. F. BARRY, LEOPARD - A SPECTRUM DEPENDENT NON-SPATIAL DEPLETION CODE FOR THE IBM7094, WCAP-3269-26, SEPTEMBER 1963.
 CREATING A LEOPARD II LIBRARY TAPE.
11. MACHINE REQUIREMENTS - 32K MEMORY AND A LIBRARY TAPE, PROGRAM TAPE, AND 5 SCRATCH TAPES
12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
FORTRAN MONITOR SYSTEM.
14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -
A COMPLETE I/O PACKAGE HAS BEEN WRITTEN IN FAP TO GET TAPE BUFFER-
ING. THIS PACKAGE COULD SIMPLY BE DISCARDED WHEN LEOPARD IS CON-
VERTED TO ANOTHER MACHINE.
15. NAME AND ESTABLISHMENT OF AUTHOR -
R. F. BARRY
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P. O. BOX 355
PITTSBURGH, PENNSYLVANIA 15230
16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7090 LEOPARD 2489 CARDS, AITP1 332 CARDS,
AITP3 172 CARDS, SPOTS 1131 CARDS)
BINARY DECKS (7090 LEOPARD 2924 CARDS, AITP1 117 CARDS,
AITP3 55 CARDS, SPOTS 182 CARDS)
SAMPLE PROBLEM (7090 LEOPARD 32 CARDS)
LIBRARIES (7090 AITP1 3095 CARDS, SPOTS 689 CARDS)
I/O TAPE BUFFERING PACKAGE (3117 CARDS)
REFERENCE REPORTS
17. CATEGORY - B
KEYWORDS - CELL CALCULATION, FAST, THERMAL, SPECTRA, DEPLETION,
DISADVANTAGE FACTORS, AITP1 CODES, AITP3 CODES, SPOTS
CODES

VI. LIBRARY PROGRAMS BY CLASSIFICATION

A. CROSS SECTION AND RESONANCE INTEGRAL CALCULATIONS

12/67

14 HAFEVER HAFEVER CALCULATES THE ENERGY EXCHANGE INELASTIC SCATTERING CROSS SECTION ACCORDING TO THE HAUSER-FESHBACH THEORY MODIFIED TO INCLUDE THE EFFECT OF SPIN-ORBIT COUPLING. THE CROSS SECTION IS INTEGRATED OVER ANGLE.

41 ZUT ZUT COMPUTES RESONANCE INTEGRALS FROM RESONANCE PARAMETERS FOR A WIDE VARIETY OF TEMPERATURES, COMPOSITIONS, AND GEOMETRIES FOR THE RESOLVED RESONANCES.

42 TUZ TUZ COMPUTES RESONANCE INTEGRALS FOR A WIDE VARIETY OF TEMPERATURES, COMPOSITIONS, AND GEOMETRIES FOR THE UNRESOLVED RESONANCES.

56 SUMMIT THE PROGRAM EVALUATES THE DIFFERENTIAL ENERGY-TRANSFER CROSS SECTION FOR SCATTERING BY A CRYSTALLINE MODERATOR, UTILIZING THE SO-CALLED PHONON EXPANSION. THE SCATTERING KERNEL FOR A 1-PHONON CHANGE IN ENERGY IS ADDED TO THAT FOR A 2-PHONON ENERGY EXCHANGE, AND SO ON. THIS PROGRAM HAS BEEN USED TO DETERMINE SCATTERING MATRICES FOR BERYLLIUM, GRAPHITE, AND OXYGEN.

$$\text{SIGMA}(E(0) \text{ TO } E)/\text{SIGMA}(0) = (((M+1)/M)**2) * \text{SQRT}(E/E(0)) * 1/2$$

THE INTEGRAL FROM -1 TO 1 OF $\text{SIGMA}(E(0) \text{ TO } E, \cos(\theta))$
 $\text{D}(\cos(\theta))$

WHERE $E(0)$ AND E ARE THE INITIAL AND FINAL ENERGIES, θ IS THE ANGLE OF SCATTERING, $\text{SIGMA}(0)$ THE FREE-ATOM CROSS SECTION, AND M THE RATIO OF THE MASS OF THE SCATTERING NUCLEUS TO THAT OF THE NEUTRON.

89 ARES2 ARES2 IS USED TO CALCULATE EFFECTIVE RESONANCE INTEGRALS AND MULTIGROUP CROSS SECTIONS FOR LUMPS AND MIXTURES USING RESONANCE PARAMETERS. IT COMBINES IN A SINGLE CODE, THE RESOLVED, UNRESOLVED, AND $1/V$ PARTS OF THE CALCULATION WHICH WERE PREVIOUSLY IN SEPARATE CODES. THE MULTIGROUP CROSS SECTIONS ARE PRINTED IN A FORM FOR USE IN MULTIGROUP REACTOR CALCULATIONS. FOR EXAMPLE, THEY CAN BE INSERTED INTO THE AIM6 (ACC ABSTRACT 29) OR FAIM (ACC ABSTRACT 120) LIBRARIES. THE ENERGY BREAKPOINTS ARE INPUT DATA AND A RESONANCE PARAMETER LIBRARY IS INCLUDED.

171 NEARREX NEARREX COMPUTES NEUTRON-INDUCED, AVERAGE FLUCTUATION (OR COMPOUND NUCLEUS) CROSS SECTIONS. PROVISION IS MADE FOR THE COMPUTATION OF COMPOUND ELASTIC AND INELASTIC NEUTRON CROSS SECTIONS, RADIATIVE CAPTURE AND FISSION CROSS SECTIONS, AS WELL AS OTHER PROCESSES, SUCH AS PROTON EMISSION. IT CAN ALSO BE USED TO COMPUTE PROTON-INDUCED AVERAGE CROSS SECTIONS.

176 RAPTURE THIS CODE COMPUTES
RESONANCE INTEGRALS, AVERAGES THEM OVER RESONANCE PARAMETRIC
DISTRIBUTIONS, AND COMPUTES FISSION AND CAPTURE CROSS SECTIONS
AS A FUNCTION OF FUEL TEMPERATURE AND OF POTENTIAL SCATTERING
CROSS SECTION PER ABSORBER ISOTOPE.

177 DOPIE DOPIE WAS DEVELOPED TO STUDY
THE EFFECTS OF -

- (1) OVERLAP OF RESONANCES OF UNLIKE FUEL ISOTOPES SUCH AS U238 AND THE PLUTONIUM ISOTOPES, AND
- (2) THE TEMPERATURE DEPENDENCE OF THE AVERAGE FLUX OVER AN ENERGY INTERVAL CONTAINING RESONANCES IN THE CALCULATION OF THE DOPPLER COEFFICIENT.

DOPIE COMPUTES FLUX-AVERAGED CROSS SECTIONS OVER A GIVEN ENERGY RANGE UNDER THE FOLLOWING ASSUMPTIONS

- (1) INTERFERENCE SCATTERING CORRECTIONS WILL BE SMALL AND CAN BE IGNORED.
- (2) SCATTERED NEUTRONS ARE DISTRIBUTED UNIFORMLY OVER THE RANGE OF ENERGY DEGRADATION CONSTANT FOR EACH MATERIAL.
- (3) ALL RESONANCES ARE RESOLVED OR CAN BE TREATED AS RESOLVED.
- (4) LEAKAGE IS INSIGNIFICANT, MAKING $\Sigma R(J) = \text{POTENTIAL SCATTERING}$.

203 COMBCC (40.0279) THE PROGRAM PERMITS COMPUTING
AND CONVOLUTING OF A COMBINATION CROSS SECTION CURVE COMPOSED OF
THE CROSS SECTION CURVES OF A SAMPLE AND UP TO FOUR CONTAMINANTS.

208 TRI11 TRI11 CALCULATES MULTI-GROUP, DOPPLER-BROADENED EFFECTIVE RESONANCE INTEGRALS AND CROSS SECTIONS AND THEIR TEMPERATURE COEFFICIENTS FOR A HETEROGENEOUS RESONANCE ABSORBER. USING BASIC RESONANCE PARAMETERS, GEOMETRY AND CONCENTRATIONS, THE CODE COMBINES RESOLVED RESONANCE, UNRESOLVED RESONANCE, AND $1/V$ AND NEGATIVE ENERGY RESONANCE CALCULATIONS. FISSILE ISOTOPE CALCULATION IS AVAILABLE. $L=1$ UNRESOLVED RESONANCE CALCULATIONS ARE AVAILABLE FOR ISOTOPE OF ALL SPINS. EQUIVALENCE RELATIONSHIPS ARE CODED FOR CYLINDERS, SPHERES, AND PLANES. INTERFERENCE BETWEEN RESONANCE AND POTENTIAL SCATTERING AND ITS TEMPERATURE DEPENDENCE ARE AVAILABLE. THE NARROW-RESONANCE, INFINITE-MASS, AND INTERMEDIATE REPRESENTATIONS OF SCATTERINGS WITH ABSORBER ATOMS ARE ALL AVAILABLE. THE ISOLATED SINGLE-LEVEL BREIT-WIGNER LINE SHAPE IS USED.

214 MISH-MASH THE PROGRAM COMPUTES RESONANCE INTEGRALS FOR INFINITE HOMOGENEOUS MIXTURES FOR ABOVE THERMAL ENERGIES. THE MAJOR PHYSICAL APPROXIMATION IS THAT RESONANCES ARE REPRESENTED BY THE SINGLE-LEVEL BREIT-WIGNER FORMULATION. IT IS ALSO ASSUMED THAT SCATTERING IS ELASTIC AND THAT A NONRESONANT MATERIAL HAS A CONSTANT SCATTERING CROSS SECTION.

215 CHAD CHAD IS DESIGNED TO FACILITATE ANALYSIS AND HANDLING OF DIFFERENTIAL NEUTRON SCATTERING DATA. IT PRODUCES LEGENDRE SCATTERING COEFFICIENTS FROM ANGULAR DISTRIBUTION DATA TABULATED IN MANY DIFFERENT FORMATS. IT CAN TRANSFORM ANGULAR DATA INTO LEGENDRE SCATTERING COEFFICIENTS IN EITHER THE LABORATORY OR THE CENTER-OF-MASS FRAME OF REFERENCE. IT CALCULATES THE AVERAGE COSINE OF THE SCATTERING ANGLE IN THE LABORATORY SYSTEM AND THE AVERAGE LOGARITHMIC ENERGY DECREMENT PER ELASTIC COLLISION.

216 FASDOP FASDOP EVALUATES POINTWISE, TEMPERATURE-DEPENDENT CROSS SECTIONS FROM SINGLE-LEVEL BREIT-WIGNER RESONANCE PARAMETERS.

217 LEGCOEF3 CALCULATES LEGENDRE EXPANSION COEFFICIENTS FOR THE ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS.

219 GAROL GAROL COMPUTES EFFECTIVE GROUP CROSS SECTIONS FOR THE RESOLVED RESONANCES OF A MIXTURE OF ISOTOPES IN A TWO-REGION CELL. BASIC CROSS SECTIONS INCLUDE TEMPERATURE DEPENDENCE. THE PROGRAM ALLOWS A CHOICE OF GEOMETRIES AND CAN ACCEPT AN ARBITRARY TABLE OF ESCAPE PROBABILITIES. A DANCORFF CORRECTION MAY BE USED TO ACCOUNT FOR SHADOWING EFFECTS IN A TIGHT LATTICE, AND CROSS SECTIONS MAY BE $1/v$, CONSTANT, COMPUTED FROM BREIT-WIGNER RESONANCE PARAMETERS, OR GIVEN IN TABULAR FORM. THE MESH MAY BE CHOSEN AT EQUAL ENERGY OR LETHARGY INTERVALS, PROPORTIONAL TO THE NEUTRON VELOCITY, OR AS AN ARBITRARY TABLE OF VALUES.

238 EXT/XO GIVEN A SET OF BREIT-WIGNER RESONANCE PARAMETERS (ZERO TEMPERATURE) EXT CALCULATES THE EFFECTIVE DOPPLER-BROADENED CROSS SECTIONS FOR ANY TEMPERATURE. THE EFFECTIVE CROSS SECTION WHEN MULTIPLIED BY THE TARGET DENSITY AND THE NEUTRON VELOCITY (LAB) GIVES THE REACTION RATE PER INCIDENT NEUTRON. A MAXWELLIAN VELOCITY DISTRIBUTION IS ASSUMED FOR THE TARGET NUCLEI. THE ANALYSIS IS CARRIED OUT FOR SUFFICIENTLY LOW ENERGIES SO THAT ONLY ZERO NEUTRON ANGULAR MOMENTA ($L = 0$) INTERACTIONS ARE IMPORTANT. INTERFERENCE BETWEEN LEVELS IS NEGLECTED, HOWEVER, INTERFERENCE BETWEEN RESONANCE SCATTERING AND POTENTIAL SCATTERING IS INCLUDED. THERE ARE PROVISIONS FOR ADDING A CORRECTION CROSS SECTION OF THE FORM $1.0/\text{SQRT}(E)$ FOR LEVELS NOT EXPLICITLY CONSIDERED. ALSO THE CROSS SECTION IN THE WINGS OF A NEGATIVE ENERGY RESONANCE, $\text{CONSTANT}/(\text{SQRT}(E) * (E - E_0) ** 2)$ MAY BE ADDED.

247 FLANGE1 FLANGE1 OPERATES ON A TABULATED NEUTRON SCATTERING LAW, $S(\alpha, \beta)$, TO DEVELOP SEVERAL TYPES OF CROSS SECTION INFORMATION. THE VARIOUS CALCULATED CROSS SECTIONS NOW AVAILABLE ARE -

- SIGMA (E-PRIME TO E, MU).
- SIGMA (E-PRIME, MU).
- SIGMAL (E-PRIME TO E).
- SIGMAL (E-PRIME).
- M2 (E-PRIME), SECOND ENERGY TRANSFER MOMENT.
- XI SIGMAS BAR, AVERAGE SLOWING DOWN POWER.
- SIGMAL (MAXWELLIAN AVERAGED).
- L REFERS TO THE LEGENDRE MOMENT. $L = 0, 1, 2, 3$ ARE AVAILABLE.
- M2 (MAXWELLIAN AVERAGED).

A TAPE OF ANGULAR CROSS SECTIONS IS PREPARED TO BE USED AS INPUT TO THE MULTIPLE SCATTERING CODE MUSE.

254 2PLUS THE 2PLUS CODE SOLVES THE PROBLEM OF THE SCATTERING OF CHARGED OR UNCHARGED NUCLEONS BY A NUCLEUS REPRESENTED BY A DEFORMED NUCLEAR POTENTIAL. THE MODEL ASSUMES THAT THE TARGET NUCLEUS HAS A 0^+ GROUND STATE AND A 2^+ FIRST EXCITED LEVEL, AND THE INTERACTION POTENTIAL HAS A QUADRUPOLE DEFORMATION. A HAUSER-FESHBACH COMPOUND NUCLEUS CALCULATION HAS BEEN INCLUDED. THE OUTPUT CONTAINS TOTAL, POTENTIAL ELASTIC, POTENTIAL INELASTIC (2^+), REACTION, AND COMPOUND NUCLEUS CROSS SECTIONS AS WELL AS ELASTIC AND INELASTIC ANGULAR DISTRIBUTIONS.

263 GASKET GASKET CALCULATES THE THERMAL NEUTRON SCATTERING LAW, $S(\alpha, \beta)$, FOR A LARGE CLASS OF MODERATORS. PROVISION HAS BEEN MADE IN GASKET FOR THE FOLLOWING DYNAMICAL MODES OF THE SCATTERER -

- (1) FREE TRANSLATION (GAS).
- (2) DIFFUSIVE OR BROWNIAN MOTION.
- (3) HARMONIC ISOTROPIC VIBRATIONS WITH CONTINUOUS FREQUENCY SPECTRUM.
- (4) HARMONIC ANISOTROPIC VIBRATIONS WITH CONTINUOUS FREQUENCY SPECTRUM (AS APPLIED FOR INSTANCE TO GRAPHITE).
- (5) HARMONIC ISOTROPIC VIBRATIONS WITH DISCRETE FREQUENCY SPECTRUM.

B. SPECTRUM CALCULATIONS, GENERATION OF GROUP CONSTANTS,
LATTICE AND CELL PROBLEMS

12/67

33 GAM1/REP/UPDATE THIS PROGRAM COMPUTES THE SLOWING-DOWN SPECTRUM IN EITHER THE P1 OR THE B1 APPROXIMATION USING 68 GROUPS OF NEUTRONS WITH A CONSTANT GROUP WIDTH $\Delta U=0.25$. MULTIGROUP CONSTANTS ARE CALCULATED FOR UP TO 32 FAST GROUPS.

50 TEMPEST2 TEMPEST2 IS A NEUTRON THERMALIZATION PROGRAM BASED UPON THE WIGNER-WILKINS APPROXIMATION FOR LIGHT MODERATORS AND THE WILKINS APPROXIMATION FOR HEAVY MODERATORS. A MAXWELLIAN DISTRIBUTION MAY ALSO BE USED. THE MODEL USED MAY BE SELECTED AS A FUNCTION OF ENERGY. THE SECOND-ORDER DIFFERENTIAL EQUATIONS ARE INTEGRATED DIRECTLY RATHER THAN TRANSFORMED TO THE RICCATI EQUATION. THE PROGRAM PROVIDES MICROSCOPIC AND MACROSCOPIC CROSS SECTION AVERAGES OVER THE THERMAL NEUTRON SPECTRUM.

51 FORM THE FORM, OR FORTRAN-MUFT, PROGRAM IS A FOURIER TRANSFORM SLOWING-DOWN CODE. A LIBRARY TAPE CONTAINING 54-GROUP MICROSCOPIC CROSS SECTIONS, RESONANCE PARAMETERS, INELASTIC SCATTERING MATRICES, AND SOURCE SPECTRA IS USED TO GENERATE A 54-GROUP FLUX SPECTRUM AND FEW-GROUP CONSTANTS.

52 SAIL THE MONOENERGETIC NEUTRON TRANSPORT EQUATION IS SOLVED USING THE DISCRETE SN METHOD FOR A ONE-DIMENSIONAL PLANE CELL. CELL PROPERTIES ARE COMPUTED.

53 S4 CYL GEOMETRY CELL CODE THIS PROGRAM SOLVES THE ONE-DIMENSIONAL MONOENERGETIC BOLTZMANN EQUATION IN CYLINDRICAL GEOMETRY, USING THE S4 APPROXIMATION. IN ADDITION TO THE FLUX DISTRIBUTION, CELL-AVERAGED PARAMETERS ARE COMPUTED.

108 BAM BAM COMPUTES THERMAL CONSTANTS, SPATIAL AND ENERGY DISTRIBUTIONS IN HETEROGENEOUS CYLINDRICAL CELLS BY ASSUMING SEPARABILITY OF SPACE AND ENERGY IN THE BOLTZMANN EQUATION.

113 ZOT ZOT TAKES MULTIGROUP NEUTRON CROSS SECTION SETS IN THE SN FORMAT (SNG, DSN, ETC.) AND REDUCES THE NUMBER OF GROUPS (COLLAPSES) ACCORDING TO A GIVEN OR COMPUTED MULTIGROUP FLUX SPECTRUM. AVERAGE VELOCITIES FOR THE FEW-GROUP SET MAY BE GENERATED ON THE BASIS OF THE FLUXES AND VOLUMES FOR A GIVEN REACTOR CONFIGURATION.

119 QUICKIE QUICKIE SOLVES THE NEUTRON SLOWING DOWN AND THERMALIZATION PROBLEM IN INFINITE MEDIA BY INVERTING A SET OF SIMULTANEOUS MULTIGROUP EQUATIONS. THE CODE USES THE ULCER (ACC ABSTRACT 118) LIBRARY TAPE AND IS IN EXCELLENT AGREEMENT WITH ULCER FOR THOSE CASES WHERE BUCKLING IS KNOWN.

147 AILMCE AILMCE IS A MODIFIED FORM OF THE ANL ELMCE PROGRAM. THE FOURIER TRANSFORM OF THE FAST NEUTRON FLUX IS FOUND FOR A MIXTURE OF MODERATORS HEAVIER THAN HYDROGEN WITH THE MODERATOR SCATTERING LAW RIGOROUSLY ACCOUNTED FOR.

149 TYCHE3 TYCHE3 IS A MONTE CARLO CODE DESIGNED TO FIND THE SECOND, FOURTH AND SIXTH MOMENTS OF THE NEUTRON SLOWING DOWN DENSITY DISTRIBUTION IN AN INFINITE HOMOGENEOUS MEDIUM. NEUTRON WEIGHTS ARE USED TO AVOID THE TERMINATION OF A HISTORY BY ABSORPTION AND MINIMIZE THE RUNNING TIME. PROVISIONS ARE MADE FOR RESTART OF NON-CONVERGED PROBLEMS, GRAPHICAL DISPLAYS OF THE MOMENTS AND AVERAGE FISSION ENERGY AS A FUNCTION OF THE NUMBER OF SETS OF HISTORIES AND CALCULATION OF THE CORRECTION TO FLUX MOMENTS.

150 DANCOFF JR. THIS CODE EVALUATES MODERATOR SPACE CHORD DISTRIBUTION FUNCTIONS OF ZEROth AND FIRST ORDER, PLUS THEIR LINEAR, SQUARE, LOGARITHMIC AND EXPONENTIAL MOMENTS, FOR REGULAR AND IRREGULAR LATTICES OF CYLINDRICAL FUEL RODS CLAD WITH MATERIAL OF NEGLIGIBLE TOTAL CROSS SECTION. OF PARTICULAR SIGNIFICANCE FOR REACTOR DESIGN CALCULATIONS IS THE EXPONENTIAL MOMENT, OR DANCOFF CORRECTION, WHICH CAN BE CALCULATED EXACTLY IN INFINITE SQUARE AND HEXAGONAL LATTICES, IN CLUMPED SQUARE LATTICES WITH STRAIGHT OR CRUCIFORM WATER GAPS, OR IN CLUSTERS OF TWO, THREE, SEVEN, AND NINETEEN FUEL RODS.

160 SOPHIST1/2/5 SOPHIST1 CALCULATES TEMPERATURE-DEPENDENT MULTIGROUP ENERGY TRANSFER COEFFICIENTS FOR A MAXWELL GAS MODERATOR WITH ELASTIC, ISOTROPIC SCATTERING IN THE CENTER OF MASS SYSTEM. SOPHIST2 CALCULATES TEMPERATURE-DEPENDENT MULTIGROUP CROSS SECTIONS FOR A MAXWELL GAS. SOPHIST5 CALCULATES MULTIGROUP ENERGY TRANSFER MATRICES FOR ANISOTROPIC ELASTIC SCATTERING.

162 GRAVE GRAVE IS THE PROGRAM TO FORM GROUP-AVERAGED CROSS SECTIONS USING THE NEUTRON CROSS SECTION MASTER TAPE DEVELOPED UNDER THE ATOMICS INTERNATIONAL AUTOMATED CROSS SECTION PROGRAM. NINETEEN GROUP-AVERAGED PARAMETERS ARE OBTAINABLE AS FOLLOWS - SIGMA T, SIGMA EL, SIGMA N, SIGMA F, NUBAR, MUBAR, XIBAR, SIGMA IN, SIGMA N-ALPHA, SIGMA N-P, SIGMA N-2N, SIGMA A, SIGMA TR, SIGMA NON-EL, ALPHABAR, XI*SIGMA EL, NU*SIGMA F, MUBAR*SIGMA EL, AND SIGMA R. THE SPECTRUM IS CONSTRUCTED FROM A COMBINATION OF FISSION, E*-N, POWER SERIES, MAXWELLIAN OR INPUT SPECTRA.

178 SPARTA SPARTA COMPUTES SPATIALLY-AVERAGED DOPPLER COEFFICIENTS AND SPATIALLY-AVERAGED DOPPLER REACTIVITY CHANGES.

184 THERMCS(ANL) THIS ARGONNE-REVISED VERSION LIKE THE ORIGINAL THERMOS CODE DEVELOPED BY H. HONECK OF BROOKHAVEN NATIONAL LABORATORY COMPUTES THE SCALAR THERMAL NEUTRON SPECTRUM AS A FUNCTION OF POSITION IN A LATTICE BY SOLVING THE INTEGRAL TRANSPORT EQUATION WITH ISOTROPIC SCATTERING. ONE-DIMENSIONAL SLAB OR CYLINDRICAL GEOMETRY MAY BE USED. AS OUTPUT THE CODE SUPPLIES FLUX-AVERAGED VALUES OF SIGMA A, SIGMA F, NU SIGMA F, SIGMA S, AND D FOR THE CELL COMPOSITION AND THE VALUES OF SIGMA A, SIGMA F, NU SIGMA F, SIGMA S, AND SIGMA TR FOR THE ISOTOPIC CONSTITUENTS.

185 GAMTEC2 GAMTEC2 GENERATES MULTIGROUP CONSTANTS IN THE ENERGY RANGE FROM 0 TO 10 MEV FOR EITHER HOMOGENEOUS MIXTURES OR HETEROGENEOUS ARRAYS CONSISTING OF CYLINDERIZED LATTICE CELLS. THE THERMAL GROUP CONSTANTS ARE AVERAGED OVER EITHER (1) WIGNER-WILKINS LIGHT MODERATOR SPECTRUM, (2) WILKINS HEAVY MODERATOR SPECTRUM, OR (3) A MAXWELLIAN DISTRIBUTION. FOR HETEROGENEOUS ARRAYS THE SPATIAL THERMAL FLUX IS CALCULATED BY A MONOENERGETIC P3 APPROXIMATION. FOR EPITHERMAL ENERGIES, THE SLOWING-DOWN DISTRIBUTION IS DESCRIBED BY EITHER A B1 OR P1 APPROXIMATION TO THE BOLTZMANN EQUATION. RESONANCE ABSORPTION AND FISSION ARE TREATED BY THE ADLER-NORDHEIM METHOD. AN IMPROVED METHOD OVER THAT IN GAM-1 FOR AVERAGING THE RESONANCE ABSORPTION CONTRIBUTION TO THE MULTIGROUP CONSTANTS IS INCLUDED. FUEL LUMPING EFFECTS ON THE FAST FISSION OF U238 AND TH232 ARE TREATED BY AN N-FLIGHT COLLISION PROBABILITY TECHNIQUE. GROUP CONSTANTS ARE PUNCHED ON CARDS IN HFN (DIFFUSION CODE) AND DTF (SN TRANSPORT CODE) FORMATS.

195 FORTRAN FMC-N/FMC-G THE FLEXIBLE MONTE CARLO PROGRAMS FMC-N AND FMC-G WERE ORIGINALLY WRITTEN IN ASSEMBLY LANGUAGE FOR THE IBM704 BY GE-ANP. THESE PROGRAMS HAVE BEEN CONVERTED TO FORTRAN FOR THE CDC16048 BY PRATT AND WHITNEY. THE PROGRAMS APPLY MONTE CARLO METHODS TO SIMULATE NEUTRON AND GAMMA RAY LIFE HISTORIES, RESPECTIVELY, IN A SOURCE-SHIELD CONFIGURATION. AS THE NAMES IMPLY, THE CODES ARE DESIGNED FOR FLEXIBILITY IN THE GEOMETRICAL, MATERIAL, NUCLEAR, AND SOURCE DESCRIPTIONS OF SOURCE-SHIELD CONFIGURATIONS AND VARIANCE REDUCTION TECHNIQUES.

201 EPITHERMOS THE EPITHERMOS CODE IS A MODIFICATION OF THE THERMOS THERMAL TRANSPORT THEORY CODE OF HONECK. THE ESSENTIAL DIFFERENCE BETWEEN THE CODES IS IN THE LIBRARY PREPARATION SUBROUTINE BASK. THE EPITHERMOS CODE IS DESIGNED TO COMPUTE THE NEUTRON DENSITY ABOVE 0.7849 EV, THE MAXIMUM ENERGY OF THE USUAL THERMOS CALCULATION. EPITHERMOS COMPUTES THE SCALAR NEUTRON DENSITY AS A FUNCTION OF POSITION AND SPEED IN A ONE-DIMENSIONAL SLAB OR CYLINDRICAL SYSTEM. THE SCATTERING MODEL IS ARBITRARY IN THE THERMAL RANGE AND THE BUILT-IN FREE GAS MODEL IS USED IN THE EPITHERMAL RANGE.

202 MCS THE MCS CODE DETERMINES THE SPATIAL DISTRIBUTION OF SOME NUCLEAR REACTION FOR A GIVEN NEUTRON SOURCE IN A GIVEN CONFIGURATION OF MATERIALS. THE MONTE CARLO ESTIMATE OF THE SOLUTION CONSISTS OF PICKING A SAMPLE OF NEUTRONS FROM THE GIVEN SOURCE AND FOLLOWING EACH NEUTRON THROUGH A SEQUENCE OF SURFACE CROSSINGS AND COLLISIONS UNTIL THE NEUTRON EITHER ESCAPES OR IS NO LONGER OF INTEREST TO THE SOLUTION. THE DESIRED FLUX OR COLLISION DENSITY IS ACCUMULATED FOR EVERY NEUTRON OF THE SAMPLE, AND THE SAMPLE SIZE INCREASED UNTIL RESULTS OF SUFFICIENT STATISTICAL SIGNIFICANCE ARE OBTAINED.

204 AGN-GAM AGN-GAM CALCULATES THE SUBGROUP FLUXES AND CURRENT TERMS FROM A SOLUTION OF THE P1 OR B1 EQUATIONS. THE P1 EQUATIONS INCORPORATE BOTH VOLUME AND SURFACE SOURCES, ALLOWING SPECTRAL CALCULATIONS IN REFLECTOR REGIONS. OTHER SPECTRAL OPTIONS ARE FLUX KNOWN, CURRENT TERM CALCULATED AND BOTH FLUX AND CURRENT TERMS KNOWN. THE AGE FOR THE MATERIAL IS OBTAINED FROM A SECOND MOMENTS CALCULATION. THE 75 SUBGROUPS USED IN THE CALCULATIONS ARE ESTABLISHED AS QUARTER LETHARGY GROUPS FROM 10 MEV TO 0.07EV. ELASTIC SCATTERING MATRICES MAINTAIN THE ENERGY-ANGLE CORRELATION BY INCLUDING BOTH P0 AND P1 TERMS. ISOTROPIC SCATTERING MATRICES ARE INCLUDED FOR INELASTIC AND (N,2N) PROCESSES. THE METHOD OF ADLER, HINMAN AND NORDHEIM IS USED TO CALCULATE RESONANCE ABSORPTION AND FISSION CROSS SECTIONS. MULTIGROUP CONSTANTS ARE GENERATED BY SPECTRAL AVERAGING OVER THE SUBGROUPS.

213 RIFF-RAFF THE PROGRAM COMPUTES RESONANCE INTEGRALS FOR ABSORBERS IN A ROD IN A TWO-REGION CIRCULARIZED CELL FOR ABOVE THERMAL ENERGIES. THE FLUX DISTRIBUTION IN THE CELL IS ALSO COMPUTED AND CAN BE PRINTED. THE METHOD OF SOLUTION IS BASED UPON THE FOLLOWING ASSUMPTIONS - ISOTROPIC SCATTERING IN THE LABORATORY SYSTEM, CONSTANT TOTAL CROSS SECTION IN THE MODERATOR AND ISOTROPIC NEUTRON FLUXES ENTERING AND LEAVING THE ROD.

235 GAMMA-P (NMP468) CROSS SECTIONS FOR THE PRODUCTION OF GAMMA RAYS BY NEUTRON RADIATIVE CAPTURE, BY NEUTRON INELASTIC SCATTERING, AND BY NEUTRON-INDUCED FISSIONING ARE COMPUTED AS A FUNCTION OF NEUTRON LETHARGY GROUPS AND PHOTON ENERGY GROUPS.

237 BOUNCE THE BOUNCE CODE DETERMINES THE ONE-GROUP THERMAL NEUTRON FLUX DISTRIBUTION WITHIN THE PIN BUNDLE OF A MULTIPLE-PIN FUEL ELEMENT. ALL SCATTERING WITHIN THE PINS IS CONSIDERED TO BE ISOTROPIC. ELEMENTS WITH 6, 7, 12, 13, 18, AND 19 FUEL PINS, WHERE EACH PIN IS COMPOSED OF A CENTRAL FUEL PELLET SURROUNDED BY A CLADDING MATERIAL, MAY BE TREATED. THE COOLANT REGION AROUND THE PINS IS ASSUMED TO CONTAIN A VOID.

243 AGN-SIGMA AGN-SIGMA CALCULATES THE LEGENDRE COMPONENTS OF THE MULTIGROUP TRANSFER MATRICES $\Sigma_{g \rightarrow g'}(L, G \text{ TO } G+N)$ FOR FAST NEUTRONS. REACTIONS CONSIDERED ARE ELASTIC SCATTERING, INELASTIC SCATTERING (LEVEL EXCITATION AND THE EVAPORATION MODEL), AND THE FOLLOWING FIVE DECAY MODES FOR THE $(N, 2N)$ REACTION -- $A(N, N1)A^*(N2)(A-1)^*$, 3- AND 4- BODY PHASE SPACE MODEL, EVAPORATION MODEL, AND THE CLUSTER MODEL, WHERE A^* IS THE RECOIL NUCLEUS. ALL NUCLEAR LEVELS INVOLVED IN THE TRANSITIONS ARE DISCRETE. THE CODE MAY ALSO BE USED TO CALCULATE GROUP-AVERAGED CROSS SECTIONS AS WELL AS TO MANIPULATE, E.G., ADD, MULTIPLY, ETC., THE OUTPUT MATRICES. THE NEUTRON SPECTRUM MAY BE A COMBINATION OF FISSION AND 1/E OR ARBITRARY INPUT DATA.

249 LASER LASER IS BASED ON MODIFIED VERSIONS OF THE SLOWING-DOWN PROGRAM MUFT AND THE THERMALIZATION TRANSPORT THEORY PROGRAM THERMOS, AND PERFORMS A CALCULATION OF THE NEUTRON SPECTRUM IN A UNIFORM LATTICE MADE UP OF CYLINDRICAL RODS, CLADDING, AND SURROUNDING MODERATOR. THE THERMAL CUTOFF IN LASER IS 1.855 EV. THE PROGRAM PERFORMS A BURNUP CALCULATION FOR THE LATTICE. THE SPATIAL DISTRIBUTION OF BURNUP WITHIN THE FUEL RODS IS EXPLICITLY CALCULATED. THE PROGRAM WILL, AT OPTION, ACCOUNT FOR ALL NON-LINEARITIES AND MUTUAL CONNECTIONS IN THE SYSTEM OF BURNUP EQUATIONS. THIS CALCULATION ACCOUNTS FOR THE VARIATION OF THE NEUTRON FLUX IN SPACE AND ENERGY DURING EACH TIME-STEP. A BUCKLING AND A BORON POISON SEARCH (CRITICALITY SEARCH) ARE PROVIDED AS OPTIONS. OUTPUT INCLUDES EDITS IN THE ENERGY RANGE ZERO LESS THAN OR EQUAL TO E LESS THAN OR EQUAL TO 0.625 EV.

257 REAX REAX CALCULATES EPITHERMAL FLUX, ACTIVITIES AND CROSS SECTIONS AS A FUNCTION OF RADIUS AND ENERGY FOR A CONSTANT TEMPERATURE FUEL ROD IMMERSED IN A HOMOGENEOUS MEDIUM.

276 AVOID AVOID COMPUTES THE EQUIVALENT DIFFUSION COEFFICIENT AND LOSS CROSS SECTION OF AN ANNULAR VOID IN A CYLINDRICAL REACTOR AND THE RADIAL FLUX DISTRIBUTION IN THE VOID.

277 HAMMER/LITHE/HELP/LIBCON HAMMER PERFORMS INFINITE LATTICE, ONE-DIMENSIONAL CELL MULTIGROUP CALCULATIONS, FOLLOWED (OPTIONALLY) BY ONE-DIMENSIONAL, FEW-GROUP, MULTIREGION REACTOR CALCULATIONS WITH NEUTRON BALANCE EDITS.

279 LEOPARD/AITP1/AITP3/SPOTS LEOPARD IS A UNIT CELL HOMOGENIZATION AND SPECTRUM GENERATION (MUFT-SOFOCATE) PROGRAM WITH A FUEL DEPLETION OPTION.

C. STATIC DESIGN STUDIES

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7 FIRM FIRM SOLVES THE TWO-DIMENSIONAL SN APPROXIMATION IN FINITE CYLINDRICAL GEOMETRY. IT IS A FORTRAN ADAPTATION OF THE LOS ALAMOS TDC PROGRAM WRITTEN BY BENGT CARLSON AND CLARENCE LEE. FIRM IS LIMITED TO A MAXIMUM OF SIX GROUPS AND THE S2, S4 OR S6 APPROXIMATION.

9 FIRE2 FIRE2 SOLVES THE ONE-DIMENSIONAL MULTIGROUP AGE-DIFFUSION EQUATIONS FOR SLAB (SYMMETRIC AND ASYMMETRIC), CYLINDER, AND SPHERE GEOMETRIES. AN EXTENSION OF THE ORIGINAL LOS ALAMOS FIRE PROGRAM WRITTEN BY F. W. BRINKLEY AND C. B. MILLS, IT CONTAINS A 34-GROUP LIBRARY OF 10 ELEMENTS.

18 2DXY THE 2DXY PROGRAM SOLVES THE HOMOGENEOUS OR INHOMOGENEOUS MULTIGROUP EQUATIONS IN X-Y GEOMETRY, USING THE SN TRANSPORT EQUATION APPROXIMATION. VACUUM, SURFACE SOURCE, OR REFLECTING BOUNDARY CONDITIONS ARE AVAILABLE AS OPTIONS. IN THE HOMOGENEOUS CASE THE USER MAY REQUEST THE COMPUTATION OF REACTIVITY, REACTOR PERIOD, CRITICAL CONCENTRATIONS OF SOME COMPOSITION, OR THE CRITICAL THICKNESS OF A ZONE.

28 FOG THE FOG PROGRAM SOLVES THE ONE-DIMENSIONAL FEW-GROUP DIFFUSION EQUATIONS IN ANY OF THREE GEOMETRIES SLAB, CYLINDER, OR SPHERE. PROVISIONS ARE MADE FOR CALCULATING THE FLUX, THE ADJOINT FLUX, AND VARIOUS CRITICALITY SEARCHES AS WELL AS A BUCKLING ITERATION AND AUTOMATIC TSCHEBYSCHIEFF POLYNOMIAL COMPUTATION OF SOURCE EXTRAPOLATION FACTORS.

29 AIM6 AIM6 SOLVES THE ONE-DIMENSIONAL MULTIGROUP DIFFUSION EQUATIONS UTILIZING A MICROSCOPIC CROSS SECTION LIBRARY. ANY OF THREE GEOMETRIES ARE AVAILABLE SLAB, CYLINDER OR SPHERE. CRITICALITY SEARCHES ARE PROVIDED INCLUDING A CONCENTRATION SEARCH ON ONE OR TWO ELEMENTS. HOMOGENEOUS AND INHOMOGENEOUS PROBLEMS MAY BE SOLVED WITH A VARIETY OF BOUNDARY CONDITION OPTIONS.

30 PERT PERT IS A PERTURBATION PROGRAM DESIGNED FOR USE WITH THE AIM6 AND FOG PROGRAMS. PUNCHED CARD OUTPUT FROM THESE CODES IS USED AS INPUT TO PERT. USING CROSS SECTION DATA, FLUXES, AND ADJOINT FLUXES, THE RELATIVE CHANGE IN K_{eff} CAN BE CALCULATED. CROSS SECTIONS MAY BE WEIGHTED WITH THE ADJOINT FLUX AND/OR DIRECT FLUX. THE NEUTRON LIFETIME FOR THE DELAY GROUPS MAY ALSO BE DETERMINED.

32 WHIRLAWAY WHIRLAWAY SOLVES THE TWO-GROUP, THREE-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN X-Y-Z GEOMETRY.

39 EQUIPOISE3 EQUIPOISE3 SOLVES THE TWO-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL OR SLAB GEOMETRY.

40 ZOGRAND ZOGRAND SOLVES THE FEW-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL OR SLAB GEOMETRY.

59 MIST MIST OBTAINS THE SOLUTION TO THE ONE-DIMENSIONAL BOLTZMANN EQUATION IN SLAB GEOMETRY. THE NUMERICAL APPROXIMATION USED IS A LINEAR ONE WHICH CAN BE DESCRIBED AS AN EXTENSION AND GENERALIZATION OF THE SN APPROXIMATION. THE EQUATIONS ARE FORMULATED IN TERMS OF A DOUBLE SN APPROXIMATION. THE BOUNDARY CONDITIONS FOR EACH GROUP MAY BE INDEPENDENTLY SPECIFIED AND PERMIT VERY GENERAL SPECIFICATIONS WITH RESPECT TO -

- (A) PERFECT MIRROR REFLECTION OR SYMMETRY, BY INPUT OF MIRROR ALBEDOS,
- (B) ANISOTROPIC DIFFUSE SOURCES, BY INPUT OF LEGENDRE POLYNOMIAL COEFFICIENTS UP TO $\lambda = 9$, OR A SHORT TABLE DESCRIBING A KNOWN ANGULAR DISTRIBUTION OF THE FLUX,
- (C) ISOTROPIC (LAMBERT SURFACE) REFLECTION.

ISOTROPIC VOLUME SOURCES IN EACH GROUP MAY ALSO BE INDEPENDENTLY SPECIFIED. THE SCATTERING FROM ONE GROUP TO ANOTHER IS ASSUMED TO BE ISOTROPIC BUT THE SCATTERING FUNCTION WITHIN EACH GROUP CAN BE A SECOND-ORDER LEGENDRE POLYNOMIAL SERIES.

75 GE-HAPD-S13 PROGRAM S CONSTRUCTS BILINEARLY COUPLED TIME-VARIANT MULTIENERGY NEUTRON-AND-PHOTON TRANSPORT AND NUCLIDE-TRANSMUTATION FIELDS HAVING SLAB, CYLINDRICAL, OR SPHERICAL SYMMETRY. ASSURANCE OF UNBIASED CONVERGENCE IS PROVIDED BY USE OF A DUAL ADJOINT-AND-FLUX LOOP CONSTRUCTED IN PRECISE CORRESPONDENCE WITH THE PHYSICS OF SUCCESSIVE FREE FLIGHTS.

87 EQUIPOISE3A EQUIPOISE-3A SOLVES THE TWO-DIMENSIONAL TWO-GROUP DIFFUSION EQUATIONS IN CYLINDRICAL OR SLAB GEOMETRY. IT IS A SLIGHTLY REVISED VERSION OF EQUIPOISE3 (ACC ABSTRACT 39). IN ADDITION TO THE STANDARD OUTPUT, A PICTURE IS PRINTED OF THE MATERIAL ARRANGEMENT IN THE REACTOR. IF THE ADJOINT FLUX OPTION IS USED, THE PROMPT NEUTRON LIFETIME IS CALCULATED AND PRINTED, WITH THE REACTIVITY PER UNIT CHANGE IN EACH GROUP CONSTANT IN EACH REGION OF THE REACTOR.

103 CRAM CRAM IS A PROGRAM TO SOLVE THE MULTIGROUP DIFFUSION EQUATIONS IN TWO-DIMENSIONS (R-Z, X-Y, OR R-THETA GEOMETRY), OR IN ONE-DIMENSION (SLAB, CYLINDRICAL, OR SPHERICAL GEOMETRY). NEUTRONS MAY SCATTER FROM ANY GROUP TO ANY OTHER. REAL, ADJOINT, AND SOURCE-TYPE PROBLEMS ARE ALL SOLVABLE. THE PROGRAM WILL COMPUTE THE K-EFFECTIVE OF THE SYSTEM OR ALTERNATIVELY SEARCH FOR CRITICALITY BY MOVING SPATIAL BOUNDARIES, VARYING MATERIAL COMPOSITIONS, OR VARYING TRANSVERSE BUCKLING.

118 ULCER ULCER IS A MULTIGROUP, ONE-DIMENSIONAL DIFFUSION EQUATION CODE WITH UPSCATTER BASED ON FAIM (ACC ABSTRACT 120). ULCER DIFFERS FROM FAIM IN THAT -

- (A) UPSCATTERING IS INCLUDED,
- (B) DOWNSCATTER TO ALL LOWER GROUPS,
- (C) MICROSCOPIC CROSS SECTIONS ARE ON TAPE,
- (D) PROVISION FOR MULTIPLE FISSION SPECTRA,
- (E) RESTART DUMP,
- (F) FEW-GROUP REDUCTION, AND
- (G) SPECTRUM COMPUTATION AND GRAPHICAL DISPLAY.

120 FAIM FAIM IS A MULTIGROUP, ONE-DIMENSIONAL DIFFUSION EQUATION PROGRAM BASED ON AIM6 (ACC ABSTRACT 29). THE PRINCIPAL FEATURES ARE -

- (A) THREE GEOMETRIES,
- (B) CALCULATION OF FLUXES AND MULTIPLICATION FACTOR,
- (C) ONE-ITERATION PROBLEMS,
- (D) CHOICE OF ONE OF FIVE SETS OF BOUNDARY CONDITIONS AT BOTH BOUNDARIES,
- (E) CRITICALITY SEARCHES ON TRANSVERSE BUCKLING, HOMOGENEOUS POISON, CRITICAL RADIUS, ONE, TWO, OR THREE ELEMENT CONCENTRATION, LOCATION OF POISON REGION BOUNDARY, LOCATION OF A FUEL REGION BOUNDARY,
- (F) ADJOINT FLUX CALCULATION, AND
- (G) EXTENSIVE DATA EDIT.

FAIMOS IS A MODIFIED VERSION OF FAIM. THREE GENERAL MODIFICATIONS WERE MADE -

- (A) THE MICROSCOPIC CROSS SECTION LIBRARY AND ITS ASSOCIATED SUBROUTINES WERE REMOVED. AS A RESULT, OPTIONS REQUIRING THE USE OF MICROSCOPIC CROSS SECTIONS ARE NOT AVAILABLE.
- (B) FAIM RAN AS A CHAIN JOB. OVERLAYS ARE NOT USED BY FAIMOS.
- (C) THE PROGRAM LANGUAGE WAS CONVERTED FROM FORTRAN II TO FORTRAN IV(H). THIS MODIFICATION MADE NECESSARY A MINOR CHANGE IN THE DATA INPUT FORMAT.

132 W-DSN W-DSN SOLVES THE DISCRETE SN EQUATIONS IN CYLINDRICAL GEOMETRY. THE EIGENVALUE OPTION IS REACTIVITY (KEFF) ONLY. VOLUME DISTRIBUTED SOURCES ARE ALLOWED, BUT NO SURFACE SOURCES.

136 HERESY1/KERNEL HERESY1 CALCULATES THE REACTIVITY, THERMAL UTILIZATION, RESONANCE ESCAPE PROBABILITY, RELATIVE ROD ABSORPTIONS AND POWER DISTRIBUTION IN HETEROGENEOUS REACTORS HAVING TWO SPATIAL DIMENSIONS. HERESY1 CAN BE USED FOR NON-UNIFORM LATTICES, LATTICES WITH MANY TYPES OF FUEL AND CONTROL RODS, AND SPIKED AND SEEDED REACTORS. FISSIONS ARE ASSUMED TO OCCUR ONLY AT THERMAL ENERGY. RESONANCE ABSORPTIONS ARE LUMPED INTO ONE EQUIVALENT RESONANCE. THE MODERATOR IS ASSUMED TO BE INFINITE IN THE RADIAL DIRECTION, AND RODS ARE TREATED AS LINE SOURCES AND SINKS. THE ROD PARAMETERS ARE INDEPENDENT OF THE INTER-ROD SEPARATION DISTANCES. SLOWING-DOWN KERNEL FUNCTIONS MAY BE OF ANY TYPE - AGE THEORY, TRANSPORT THEORY, OR EMPIRICAL. A SELF-CONSISTENT PROCEDURE CAN BE USED WHICH EFFECTIVELY CANCELS OUT ANY ERRORS IN THE KERNEL FUNCTIONS.

144 DTF THE DTF PROGRAM IS A ONE-DIMENSIONAL MULTIGROUP PROGRAM FOR SOLVING THE NEUTRON TRANSPORT EQUATION. THE PROGRAM CAN DETERMINE THE REGULAR OR ADJOINT SOLUTION FOR SLAB, CYLINDRICAL, OR SPHERICAL GEOMETRY. ISOTROPIC OR A FORM OF LINEAR ANISOTROPIC SCATTERING MAY BE CONSIDERED. VARIOUS BOUNDARY CONDITIONS ARE ALLOWED SO THAT CELLS OR TIME-DEPENDENT SOLUTIONS MAY BE OBTAINED USING FINITE AS WELL AS INFINITE CONFIGURATIONS IN THE CASE OF SLABS OR CYLINDERS. THE PROGRAM ALSO CONTAINS A NUMBER OF SEARCH OPTIONS WHEREBY ONE CAN VARY DIMENSIONS OR CONCENTRATIONS TO ARRIVE AT A PREDETERMINED EIGENVALUE. DISTRIBUTED OR SHELL SOURCES MAY BE SPECIFIED AT ANY POSITION WITHIN THE CONFIGURATION. AS OUTPUT THE PROGRAM SUPPLIES THE EIGENVALUE, ANGULAR FLUXES (TOTAL FLUXES, FISSION DISTRIBUTIONS, AND OTHERS QUANTITIES. A LIBRARY OF CROSS SECTIONS IS AVAILABLE ON MAGNETIC TAPE. CROSS SECTIONS MAY BE READ FROM THIS LIBRARY TAPE AND/OR FROM CARDS.

148 TOPIC TOPIC SOLVES THE ONE-DIMENSIONAL BOLTZMANN EQUATION IN CYLINDRICAL GEOMETRY WITH UP TO SIX ENERGY GROUPS, 240 SPACE POINTS, 40 REGIONS, AND ANISOTROPIC (P1) SCATTERING.

THE BOUNDARY CONDITIONS FOR EACH GROUP CAN BE INDEPENDENTLY SPECIFIED AND THE FLEXIBILITY OF THE SPECIFICATIONS PERMIT -

- (A) PERFECT MIRROR REFLECTION OR SYMMETRY,
- (B) ISOTROPIC REFLECTION (LAMBERT SURFACE REFLECTION), AND
- (C) ANISOTROPIC DIFFUSE SOURCES BY MEANS OF EITHER
A P1 LEGENDRE SERIES OR A SHORT TABLE OF POINT VALUES FOR
THE ANGULAR FLUX.

INDEPENDENT SPECIFICATION OF ISOTROPIC FIXED VOLUME SOURCES FOR EACH GROUP IS ALSO ALLOWED.

AS IMPLIED, BOTH HOMOGENEOUS AND INHOMOGENEOUS PROBLEMS ARE SOLVED, AND FISSIONS CAN OCCUR IN EITHER TYPE OF PROBLEM.

151 DTF2/ANISN THE MULTIGROUP, ONE-SPACE DIMENSION NEUTRON TRANSPORT EQUATION IS SOLVED. ISOTROPIC OR LINEAR ANISOTROPIC SCATTERING IS PERMITTED BETWEEN ALL GROUPS AND A DIFFUSION SOLUTION MAY BE OBTAINED FOR ANY OR ALL GROUPS. HIGH-ORDER ANISOTROPIC SCATTERING PROBLEMS (PL) CAN BE RUN USING ANISN, THE 360 VERSION OF DTF2. WHITE/GREY BOUNDARY CONDITIONS ARE AVAILABLE, AND AN ALBEDO CAN BE SPECIFIED FOR EACH GROUP. A VOID STREAMING CORRECTION IS INCLUDED. A COMPLETE SHELL SOURCE DESCRIPTION BY GROUP, POSITION, AND ANGLE IS AVAILABLE. GRAPHICAL DISPLAY (CRT) FEATURES ARE AVAILABLE WITH ANISN.

156 EXTERMINATOR THE MULTIGROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y, R-Z, OR R-THETA GEOMETRY.

161 FORTRAN TDC TDC SOLVES THE BOLTZMANN EQUATION IN MULTIGROUP FORM FOR THE TRANSPORT OF NEUTRONS OR THE ADJOINT EQUATION IN FINITE (R,Z) CYLINDRICAL GEOMETRY BY THE DISCRETE SN METHOD. THE PROBLEM MAY BE HOMOGENEOUS (NO SOURCES INDEPENDENT OF FLUXES) OR INHOMOGENEOUS, BUT ALL SOURCES MUST BE ISOTROPIC. NEUTRON SCATTERING MUST ALSO BE ISOTROPIC. A HOMOGENEOUS PROBLEM MAY BE SOLVED FOR THE EIGENVALUE K-EFF OR THE EIGENVALUE ALPHA (TIME CONSTANT). ALTERNATIVELY, THE HOMOGENEOUS PROBLEM MAY BE SOLVED FOR THE SIZE (RADIUS, HEIGHT OR BOTH) OF THE SYSTEM CORRESPONDING TO A SPECIFIED K-EFF OR FOR THE ATOM CONCENTRATION OF SOME MATERIAL CORRESPONDING TO A SPECIFIED EIGENVALUE K-EFF OR ALPHA. FOR INHOMOGENEOUS PROBLEMS, THE IMPOSED SOURCE MAY BE AN ISOTROPIC VOLUME-DISTRIBUTED SOURCE OR AN ISOTROPIC SHELL SOURCE ON THE OUTER BOUNDARY.

167 FLARE FLARE IS AN INEXPENSIVE CALCULATIONAL METHOD TO DETERMINE CORE REACTIVITY AND CORE POWER DISTRIBUTION. A SCOPING CALCULATION OF THIS TYPE IS VALUABLE IN APPRAISING THE PHYSICS CHARACTERISTICS OF PLANNED TEST MODES OF OPERATION SO THAT DETAILED ANALYSIS CAN BE RESERVED FOR THOSE CORE CALCULATIONS OF GREATER INTEREST FROM EITHER A TECHNICIAN OR SAFETY STANDPOINT.

173 2DF 2DF IS A TWO-DIMENSIONAL MULTIGROUP PROGRAM WRITTEN IN FORTRAN FOR SOLVING THE NEUTRON TRANSPORT EQUATION USING THE S(N) METHOD. THE PROGRAM CAN DETERMINE THE REAL OR ADJOINT SOLUTION FOR X-Y, R-Z, OR R-THETA GEOMETRY. ISOTROPIC OR A FORM OF LINEAR ANISOTROPIC SCATTERING MAY BE CONSIDERED. VARIOUS BOUNDARY CONDITIONS ARE ALLOWED. THE PROGRAM ALSO CONTAINS A NUMBER OF SEARCH OPTIONS WHEREBY ONE CAN VARY DIMENSIONS OR CONCENTRATIONS TO ARRIVE AT A PREDETERMINED EIGENVALUE. A DISTRIBUTED SOURCE MAY BE SPECIFIED. A LIBRARY OF CROSS SECTIONS IS AVAILABLE ON MAGNETIC TAPE. CROSS SECTIONS MAY BE READ FROM THE LIBRARY TAPE AND/OR FROM CARDS.

192 2DXYL THE 2DXY PROGRAM (ACC ABSTRACT 18) HAS BEEN CONVERTED FROM FLOCO TO FORTRAN 63 FOR USE ON THE CDC1604 WITH CHANGES TO PERMIT THE INCLUSION OF FIXED SOURCE TERMS FROM TDC - TERMS REPRESENTING THE EFFECTIVE NET LOSS PER UNIT VOLUME DUE TO AXIAL LEAKAGE. IN THIS MANNER, A THREE-DIMENSIONAL FLUX SYNTHESIS CODE IS ACHIEVED.

199 TDP TDP IS A TWO-DIMENSIONAL LINEAR PERTURBATION THEORY CODE WHICH CALCULATES REACTIVITY COEFFICIENTS, PROMPT NEUTRON LIFETIMES, AND EFFECTIVE DELAYED FRACTIONS USING FLUXES FROM TDC CYLINDRICAL (R-Z) OR RECTANGULAR (X-Y) GEOMETRY.

209 DTF4 THE LINEAR, TIME-INDEPENDENT, BOLTZMANN EQUATION FOR PARTICLE TRANSPORT IS SOLVED FOR THE ENERGY, SPACE, AND ANGULAR DEPENDENCE OF THE PARTICLE DISTRIBUTION IN ONE-DIMENSIONAL SLABS, CYLINDERS, AND SPHERES. INDEPENDENT SOURCE OR EIGENVALUE (MULTIPLICATION, TIME-ABSORPTION, ELEMENT CONCENTRATION, ZONE THICKNESS OR SYSTEM DIMENSION) PROBLEMS ARE SOLVED SUBJECT TO VACUUM, REFLECTIVE, OR PERIODIC BOUNDARY CONDITIONS. A COMPLETE ENERGY-TRANSFER SCATTERING MATRIX IS ALLOWED FOR EACH LEGENDRE COMPONENT OF THE SCATTERING CROSS SECTION MATRICES.

211 MGDSN MGDSN IS A MODIFICATION OF DSN, THE ONE-DIMENSIONAL THEORY CODE DESIGNED TO ACCOMMODATE 100 GROUP ISOTROPIC MATERIAL CROSS SECTION DATA TAPES PREPARED BY CSP1 AND CSP2A.

212 VARI-QUIR THE TIME-DEPENDENT, MULTI-GROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y OR R-Z GEOMETRY.

220 GASP2 SOLVES FOR THE ONE-DIMENSIONAL DISTRIBUTION OF FISSILE AND FERTILE MATERIALS IN A NUCLEAR REACTOR WHICH WILL YIELD ANY DESIRED POWER DISTRIBUTION AND APPROXIMATELY RETAIN THIS DESIRED POWER DISTRIBUTION DURING THE BURN-UP HISTORY OF THE REACTOR CORE. A POISON AND POISON DISTRIBUTION SEARCH FOR A DESIRED MULTIPLICATION AND MINIMUM POWER DISTRIBUTION PERTURBATION CAN ALSO BE PERFORMED.

222 GAMBLE4 STEADY-STATE TWO-DIMENSIONAL SOLUTION FOR THE MULTIGROUP NEUTRON DIFFUSION EQUATIONS WITH ARBITRARY GROUP-TO-GROUP ENERGY COUPLING.

241 HFN HFN SOLVES THE HOMOGENEOUS OR INHOMOGENEOUS ONE-DIMENSIONAL MULTIGROUP DIFFUSION EQUATION FOR ITS LOWEST EIGENVALUE AND THE CORRESPONDING DIRECT AND/OR ADJOINT EIGENVECTORS. INHOMOGENEOUS BOUNDARY CONDITIONS AND A FLEXIBLE SCATTER-TRANSFER MATRIX STRUCTURE ARE INCLUDED. OPTIONAL CALCULATIONS INCLUDE CRITICALITY SEARCHES, DETECTOR ACTIVATION TRAVERSES, AND INTEGRALS FOR PERTURBATION THEORY ANALYSIS.

262 MACH1 MACH1 PERFORMS ONE-DIMENSIONAL MULTIGROUP DIFFUSION SOLUTIONS AND ASSOCIATED CALCULATIONS, INCLUDING CRITICALITY SEARCHES, PERTURBATION, REACTION SUMMARY, BETA EFFECTIVE, GROUP COLLAPSING, AND POINTWISE REACTION RATES AND RATIOS. SEVERAL CARD DUMPS OF COMPUTED DATA ARE AVAILABLE ON OPTION.

264 VARI-CUIR3 THE STEADY-STATE, MULTIGROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y, R-Z, AND R-THETA GEOMETRY.

270 CAESAR4/LIBLST CAESAR4 SOLVES THE ONE-DIMENSIONAL, MULTIGROUP DIFFUSION EQUATIONS IN ANY OF THREE GEOMETRIES AND PROVIDES A WIDE CHOICE OF BOUNDARY CONDITIONS, CRITICALITY SEARCHES, EDITS AND OTHER AUXILIARY COMPUTATIONS.

D. DEPLETION, FUEL MANAGEMENT, COST ANALYSIS, AND REACTOR ECONOMICS

12/67

55 AIMFIRE THIS PROGRAM WAS DESIGNED TO COMPARE THE COSTS OF VARIOUS FUEL CYCLES. THE PROGRAM CONTAINS A LIBRARY OF FAST AND THERMAL MICROSCOPIC CROSS SECTIONS, DECAY CONSTANTS, AND FISSION YIELDS FOR 50 ISOTOPES. THE PRESENT VERSION IS USED TO INVESTIGATE THE ECONOMICS OF URANIUM FUEL SYSTEMS.

58 SIZZLE SIZZLE SOLVES THE ONE-DIMENSIONAL, OR MULTIGROUP BURNUP PROBLEM IN THE DIFFUSION THEORY APPROXIMATION FOR FAST INTERMEDIATE REACTORS. AFTER THE INITIAL CALCULATION AT T=0, AVERAGE CROSS SECTIONS ARE COMPUTED FOR FURTHER CALCULATIONS USING ONE TO SIX ENERGY GROUPS. CRITICALITY MAY BE MAINTAINED BY USE OF A CONCENTRATION SEARCH. THE CONCENTRATION OF THE VARIOUS ISOTOPES IS PERMITTED TO VARY ONLY FROM REGION-TO-REGION. CHAINS INCLUDED ARE TH232, U238, AND A FISSION PRODUCT POISON CHAIN.

99 DUO DIMENSIONAL BURNOUT(DDB) THE FIVE-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL GEOMETRY ARE SOLVED WITH BURNOUT OPTIONS AND CONTROL ROD SEARCH OPTIONS.

117 FEVER FEVER PERFORMS ONE-DIMENSIONAL FEW-GROUP DEPLETION CALCULATIONS. OPTIONS ARE AVAILABLE TO ADJUST CONTROL POISONS IN VARIOUS REGIONS OF THE REACTOR, SELF-SHIELDING OF LUMPED POISONS, AND TO CALCULATE HOT MAXIMUM AND COLD SHUT-DOWN MULTIPLICATION.

134 NUCY THE CALCULATION OF NUCLIDE CONCENTRATIONS AT A POINT IN A REACTOR AT SUCCESSIVE TIME INTERVALS, WITH EXPOSURE TO A TWO-GROUP NEUTRON FLUX. INFINITE SYSTEM CRITICALITY IS CALCULATED.

146 NPRFCCP NUCLEAR FUEL CYCLE COSTS IN DOLLARS PER YEAR (\$/YR), AND IN MILLS PER KILOWATT-HOUR (MILLS/KWHR) ARE COMPUTED AND TABULATED FOR EACH REGION OF A MULTIREGION REACTOR CORE, ON THE BASIS OF AEC-LEASED NUCLEAR FUEL MATERIAL AND OF PRIVATELY-OWNED NUCLEAR FUEL MATERIAL. FUEL CYCLE COSTS ARE COMPUTED SEPARATELY FOR EACH REGION OR ZONE, FOR CORE DESIGNS OF ANY CONFIGURATION OR COMBINATION OF MATERIAL DEPLETION OR ENRICHED URANIUM FUEL OR OTHER SPECIAL NUCLEAR MATERIAL. PRINTED OUTPUT OF THE PROGRAM INCLUDES (A) DETAILED FUEL CYCLE COSTS FOR EACH ZONE IN TABULAR FORM, FOR AEC-LEASED AND PRIVATELY-OWNED NUCLEAR FUEL MATERIAL, RESPECTIVELY, (B) A SUMMARY TABULATION OF NUCLEAR FUEL COSTS FOR ALL REGIONS OF THE COMPLETE CORE, INCLUDING FIXED CHARGES ON WORKING CAPITAL REQUIRED FOR CORE FABRICATION AND FOR NUCLEAR FUEL MATERIAL, (C) A SUMMARY TABULATION OF CERTAIN COMPUTED PERFORMANCE AND ECONOMIC DATA, VIZ., AVERAGE RESIDENCE TIME, ANNUAL FUEL THROUGHPUT, UNIT ELECTRICAL ENERGY YIELD, ANNUAL POWER GENERATION, AND CORE FABRICATION COSTS, AND (D) A TABULATION OF ALL INPUT DATA FOR ALL REGIONS. THE PRINTING OF DATA DESCRIBED IN (A) AND (D) ABOVE IS OPTIONAL WITH PROGRAM USE.

179 ISOTOPES THIS PROGRAM CAN BE USED TO CALCULATE FOR ANY NEUTRON FLUX THE OPTIMUM TIME OF IRRADIATION FOR MAXIMUM YIELD, THE SPECIFIC ACTIVITY OF THE PRODUCT ISOTOPE IN CURIES PER GRAM OF TARGET MATERIAL, AND THE COMBINED SPECIFIC ACTIVITY OF THE TARGET AND PRODUCT ISOTOPES. THE PRODUCT ISOTOPE MAY BE PRODUCED BY ANY SIMPLE REACTION SUCH AS (N,GAMMA), (N,P), (N,2N), ETC., OR IT MAY BE PRODUCED BY DECAY OF A PARENT ISOTOPE.

180 ISOCRUNCH ISOCRUNCH CAN BE USED TO COMPUTE THE AMOUNT OF EACH ISOTOPE IN A REACTION AND DECAY CHAIN FOR ANY SPECIFIED NEUTRON FLUX AND TIME, TO SUM THE CONTRIBUTIONS OF VARIOUS CHAINS TO THE SAME ISOTOPE, TO GRAPH ON AN ASSOCIATED ELECTROPLOTTER OR CALCOMP THE YIELD OF AN ISOTOPE VS. TIME FOR A GIVEN FLUX, AND TO FIND THE OPTIMUM TIME FOR MAXIMUM YIELD OF AN ISOTOPE IN A CHAIN. THE PROGRAM DOES NOT TAKE INTO ACCOUNT THE SELF-SHIELDING OF A TARGET IN A REACTOR OR THE DEPENDENCE OF REACTION CROSS SECTIONS ON NEUTRON ENERGY WHICH CAN BE HANDLED BY ADJUSTING THE INPUT DATA.

221 RELOAD-FEVER A FEW-GROUP, 1-D DEPLETION CALCULATION WHICH ALLOWS FUEL IN VARIOUS STAGES OF IRRADIATION TO BE HOMOGENIZED INTO THE SAME REGION FOR PURPOSES OF THE DIFFUSION CALCULATION BUT FOLLOWS THE DEPLETION OF EACH OF THE SUB-REGIONS SEPARATELY. THE CALCULATION MAY BE INTERRUPTED PERIODICALLY FOR REFUELING ONE OR MORE REGIONS. RECYCLING IS OPTIONAL AND THERE IS NO LIMIT TO THE NUMBER OF REFUELINGS WHICH MAY BE PERFORMED. A CONTROL POISON SEARCH IS AVAILABLE AND CONCENTRATION DEPENDENT SELF-SHIELDING FACTORS MAY BE APPLIED TO ONE LUMPED POISON.

223 REVISED-GAD THIS INFINITE-MEDIUM DEPLETION PROGRAM PERFORMS FUEL CYCLE CALCULATIONS ON REACTORS EMPLOYING PARTIAL REFUELING. THE BURN-UP OF UP TO 12 DISCRETE FUEL COMPOSITIONS (REGIONS OR STAGES OF IRRADIATION) MAY BE FOLLOWED SIMULTANEOUSLY. THE BURN-UP CALCULATION MAY BE INTERRUPTED PERIODICALLY TO REMOVE THE CONTENTS AND TO REFUEL ONE OR MORE REGIONS. FUEL MAY BE PARTIALLY OR COMPLETELY RECYCLED.

224 WAMPUM THIS PROGRAM CALCULATES FUEL CYCLE COSTS ON A DETAILED BASIS, USING RESULTS OF NUCLEAR DEPLETION CALCULATIONS AND CERTAIN SPECIFIED ECONOMICS ASSUMPTIONS. THE PURPOSE IS TO PROVIDE A MEASURE OF PERFORMANCE FOR COMPARING OR OPTIMIZING FUEL CYCLES AND ASSOCIATED REACTOR CORE AND FUEL ELEMENT CHARACTERISTICS.

225 TEMCO TEMCO COMPUTES REACTOR TEMPERATURE COEFFICIENTS.

226 OPUS THE CODE GENERATES A FLOW NETWORK EQUIVALENT TO A GAS-COOLED NUCLEAR POWER PLANT OF SPECIFIED ELECTRICAL OUTPUT (IN THE RANGE OF 100 TO 1000 MW) ACCORDING TO INPUT DATA AND PROGRAMMED RULES, PROCEEDS TO EVALUATE THE PLANT PERFORMANCE AND PRICE OF THE TURBOGENERATOR SET (ACCORDING TO GENERAL ELECTRIC PRICE DATA), AND PRINTS AS A RESULT A CODED LIST OF ALL PLANT COMPONENTS AND A DETAILED PERFORMANCE MAP.

227 STMGEN STMGEN WILL BE USED IN A PLANT OPTIMIZATION PROGRAM. THIS CODE DETERMINES THE AREA OF EACH SECTION OF A STEAM GENERATOR REQUIRED TO SATISFY THE DESIGN CONDITIONS OF HEAT TRANSFER, PRESSURE DROP AND MAXIMUM TUBE TEMPERATURE CONSTRAINTS. THE COST OF THE GENERATOR IS COMPUTED AS A FUNCTION OF THE TOTAL HEAT TRANSFER AREA, THE NON-PRODUCTIVE TUBE LENGTH REQUIRED TO CONNECT THE HEADERS, PLUS THE COST OF THE HEADERS.

231 RAD2 THIS PROGRAM CALCULATES THE FISSION PRODUCT ACTIVITY DISTRIBUTIONS IN A HIGH TEMPERATURE GAS-COOLED REACTOR SYSTEM.

240 ASSAULT MULTIGROUP, TWO-DIMENSIONAL REACTOR DEPLETION. GIVEN NUCLIDE CONCENTRATIONS AND MICROSCOPIC CROSS SECTIONS, THE STEADY-STATE MULTIREGION, MULTIGROUP DIFFUSION EQUATIONS ARE SOLVED IN ONE OR TWO DIMENSIONS OVER A FINITE-DIFFERENCE SYSTEM OF MESH POINTS. THE CALCULATED NEUTRON FLUXES ARE THEN USED TO DETERMINE NUCLIDE CONCENTRATIONS AFTER A SPECIFIED PERIOD OF EXPOSURE. THESE CALCULATIONS ARE REPEATED FOR A SPECIFIED NUMBER OF TIME-STEPS.

260 GARGOYLE GARGOYLE IS AN INFINITE MEDIUM DEPLETION CODE FOR FUEL CYCLE CALCULATIONS ON REACTORS EMPLOYING PARTIAL REFUELING. THE BURNUP OF UP TO 12 DISCRETE FUEL COMPOSITIONS (REGIONS OR STAGES OF IRRADIATION) MAY BE FOLLOWED SIMULTANEOUSLY. THE BURNUP CALCULATION MAY BE INTERRUPTED PERIODICALLY TO REMOVE THE CONTENTS OF AND TO REFUEL ONE OR MORE REGIONS. FUEL MAY BE COMPLETELY OR PARTIALLY RECYCLED. A CONTROL POISON SEARCH MAY BE PERFORMED AT EACH TIME-STEP. FEED FUEL SEARCHES ARE PERMITTED AT THE END OF EACH BURNUP CYCLE BEFORE REFUELING. CONCENTRATION DEPENDENT SELF-SHIELDING FACTORS MAY BE APPLIED TO ANY NUCLIDE EXCEPT MODERATORS. THE NUCLIDE SCHEME EMPLOYED, ALTHOUGH NOT COMPLETELY GENERAL, IS FLEXIBLE.

269 DTF-BURN DTF-BURN IS A ONE-DIMENSIONAL, MULTIGROUP BURNUP CODE BASED ON TRANSPORT THEORY. A DIFFERENT TYPE OF EIGENVALUE CALCULATION (MULTIPLICATION, PERIOD, NUCLIDE CONCENTRATION, ZONE THICKNESS, OR SYSTEM DIMENSION) CAN BE PERFORMED AT THE BEGINNING OF EACH OF A SPECIFIED SET OF TIME-STEPS. THIS FEATURE PERMITS THE SIMULATION, IN A SINGLE PROBLEM RUN, OF A SYSTEM IN WHICH VARIOUS CONTROL METHODS ARE USED AS A FUNCTION OF TIME. THE CONCENTRATION OF THE VARIOUS NUCLIDES IS PERMITTED TO VARY FROM REGION-TO-REGION OR POINT-BY-POINT. NUCLIDES CONSIDERED ARE U235, U236, U238, NP239, PU239, PU240, PU241, PU242, AND FP, A PSEUDO FISSION PRODUCT PAIR.

R275 PDQ7 PDQ7 SOLVES FEW-GROUP NEUTRON DIFFUSION-DEPLETION PROBLEMS IN ONE, TWO, AND THREE DIMENSIONS. ADJOINT SOLUTIONS ARE ALSO AVAILABLE AND TWO OVERLAPPING THERMAL GROUPS MAY BE USED IN ONE AND TWO-DIMENSIONAL PROBLEMS. EITHER POINTWISE OR REGIONWISE DEPLETION MAY BE PERFORMED USING THE HARMONY DEPLETION SYSTEM. THE GEOMETRY MAY BE RECTANGULAR, CYLINDRICAL, OR SPHERICAL IN ONE DIMENSION, RECTANGULAR, CYLINDRICAL, OR HEXAGONAL IN TWO DIMENSIONS, AND RECTANGULAR OR HEXAGONAL IN THREE DIMENSIONS. ALL GEOMETRIES PROVIDE FOR VARIABLE MESH SPACING IN ALL DIMENSIONS. ZERO FLUX, ZERO CURRENT, AND ROTATIONAL SYMMETRY BOUNDARY CONDITIONS ARE AVAILABLE, AND BOUNDARY VALUE PROBLEMS MAY BE SOLVED BY SPECIFYING THE FLUX VALUES ON ONE OR MORE BOUNDARIES.

E. SPACE-INDEPENDENT KINETICS

12/67

121 AIREK3 AIREK3 FINDS THE NUMERICAL SOLUTION TO THE SPACE INDEPENDENT REACTOR KINETICS EQUATIONS BASED ON THE METHOD DEVELOPED BY E. R. COHEN. INPUT AND OUTPUT ARE SIMPLIFIED AND THE POWER, INVERSE PERIOD, FEEDBACKS, AND PRECURSORS ARE DISPLAYED GRAPHICALLY.

122 SNAPKIN5/SNAPKIN5A SNAPKIN5 PROVIDES A ONE-REGION TIME-DEPENDENT CALCULATION OF POWER, ENERGY, TEMPERATURE, REACTIVITY, INVERSE PERIOD, AND HYDROGEN LOSS IN A SNAP REACTOR AFTER A PERTURBATION FROM GIVEN INITIAL CONDITIONS. SNAPKIN-5A, IN ADDITION, WEIGHS POWER, HEAT CAPACITY, AND REACTIVITY IMPORTANCE FOR TWENTY-FIVE OR FEWER REGIONS.

135 TRAFICORPORATION EXPERIMENTAL FREQUENCY RESPONSE DATA OBTAINED FROM A LINEAR DYNAMIC SYSTEM IS PROCESSED TO OBTAIN THE TRANSFER FUNCTION AS A RATIO OF TWO FREQUENCY-DEPENDENT POLYNOMIALS. THE TRANSFER FUNCTION MAY HAVE NON-MINIMUM PHASE.

163 AIROS AIROS SOLVES THE SPACE-INDEPENDENT REACTOR KINETICS EQUATIONS AND PROVIDES FOR THE DETERMINATION OF REACTIVITY BY SOLVING IN ADDITION THE DISCRETIZED EQUATIONS WHICH REPRESENT THE SPATIAL HEAT AND MASS TRANSFER MODEL FOR SEVERAL FUEL CHANNELS. IN ADDITION, VARIATION OF THE FILM COEFFICIENT WITH FLOW IS ACCOUNTED FOR AS WELL AS THE PROVISION FOR FLOW DECAY AND AFTERGLOW HEATING. SCRAMS CAN BE INITIATED BY DELAYED SIGNALS FROM INSTRUMENTS WHICH SENSE ANY QUANTITY CALCULATED, E.G., POWER, INVERSE PERIOD OR TEMPERATURE. GENERALIZED FEEDBACK EQUATIONS ARE USED TO PROVIDE FLEXIBILITY IN THE MODELS THAT REPRESENT MULTICHANNEL HEAT TRANSFER INCLUDING CONDUCTION AND CONVECTION, ENERGY, PRESSURE AND OTHER PHENOMENON. THE REACTIVITY EQUATION IS ALSO GENERALIZED. THE REACTIVITY FEEDBACK COEFFICIENTS CAN BE CONSTANT OR VARY AS THE SQUARE ROOT OR RECIPROCAL OF TEMPERATURE. FURTHERMORE ANY FEEDBACK VARIABLE CAN BE USED TO INITIATE A REACTIVITY SCRAM, EACH WITH A UNIQUE DELAY TIME.

168 INVERSE KINETICS (R102) GIVEN THE SPACE-INDEPENDENT, ONE ENERGY GROUP REACTOR KINETICS EQUATIONS AND THE INITIAL CONDITIONS, THIS PROGRAM DETERMINES THE TIME VARIATION OF REACTIVITY REQUIRED TO PRODUCE THE GIVEN INPUT OF FLUX-TIME DATA.

188 CMPXMAT A SYSTEM OF N LINEAR EQUATIONS DERIVED FROM THE LAPLACE TRANSFORM OF A SET OF LINEARIZED DIFFERENTIAL EQUATIONS IS SOLVED FOR AMPLITUDE AND PHASE ANGLE AS A FUNCTION OF FREQUENCY.

255 R101 R101 SOLVES THE SPACE-INDEPENDENT, ONE-ENERGY GROUP REACTOR KINETICS EQUATIONS TO DETERMINE THE TIME VARIATION OF NEUTRON DENSITY GIVEN SPECIFIED INITIAL CONDITIONS. ANY OF FOUR PROGRAMMED REPRESENTATIONS OF EXCESS REACTIVITY CAN BE SELECTED.

102 AX1 AX1 PERFORMS A COUPLED NEU-
TRONICS-HYDRODYNAMICS CALCULATION. GIVEN A SPHERICALLY SYMMETRIC,
SUPERPROMPT CRITICAL SYSTEM, THE PROGRAM COMPUTES THE VARIATION IN
TIME AND SPACE OF THE SPECIFIC ENERGY, TEMPERATURE, PRESSURE,
DENSITY AND VELOCITY.

129 CONEC CONEC IS A COUPLED NEUTRONIC-ELASTICITY CODE DESIGNED FOR APPLICATION TO PULSED FAST REACTOR SYSTEMS. IT IS A ONE-DIMENSIONAL CALCULATION, CAPABLE OF DEALING WITH SOLID SPHERES OR SPHERICAL SHELLS. SPECIFICALLY, CONEC CALCULATES THE ALPHA OF A SYSTEM, THE TEMPERATURE DISTRIBUTION, THE RADIAL AND TANGENTIAL STRESS DISTRIBUTIONS, AND FROM THESE THE ACCELERATIONS, VELOCITIES, AND DISPLACEMENTS THROUGHOUT THE SYSTEM.

145 WEAK EXPLOSION PROGRAM THIS PROGRAM PERFORMS A
COUPLED NEUTRONICS-HYDRODYNAMICS CALCULATION FOR A SPHERICALLY
SYMMETRIC REACTOR CORE WITH A GIVEN COMPOSITION TO OBTAIN THE
TIME-DEPENDENT ENERGY RELEASE THAT RESULTS FROM THE INSERTION OF
REACTIVITY AT A GIVEN RATE. THE BASIC USE FOR THIS PROGRAM IS
FOUND IN ANALYSIS OF FAST REACTOR CORE COLLAPSE ACCIDENTS.

153 HATCHET HATCHET IS A MAJOR MODIFICATION OF THE AX1 CODE DESIGNED TO STUDY BURST CHARACTERISTICS OF A SUPERPROMPT CRITICAL, CONCENTRIC SHELL, PULSED REACTOR. IT COMPUTES SPECIFIC ENERGY, TEMPERATURE, PRESSURE, DENSITY AND VELOCITY VARIATIONS AS A FUNCTION OF TIME AND SPACE. THE CODE ALSO COMPUTES REACTIVITY AS A FUNCTION OF INVERSE REACTOR PERIOD, POWER, THE TOTAL AND KINETIC ENERGIES, AND THE POSITION OF THE SHELLS WHICH COMPRISE THE SYSTEM.

174 FORE/FORE2 FORE CALCULATES REACTOR POWER AND TEMPERATURES OF FUEL, COOLANT, CLAD, AND STRUCTURE AS FUNCTIONS OF TIME IN RESPONSE TO A PROGRAMMED REACTIVITY INSERTION SPECIFIED AS A SERIES OF RAMPS. TEMPERATURE PROFILES ARE COMPUTED AT SPECIFIED AXIAL POSITIONS FOR AN AVERAGE CHANNEL AND FOR THE PEAK POWER (CENTRAL) CHANNEL. THE HEAT OF FUSION ACCOMPANYING FUEL MELTING IS TAKEN INTO ACCOUNT. FEEDBACK REACTIVITY MECHANISMS THAT RESPOND TO CHANGES OF TEMPERATURES INCLUDE THE FUEL DOPPLER EFFECT AND THERMAL EXPANSION OF THE CORE (AND AXIAL BLANKET OR REFLECTOR) MATERIALS. FORE2 IS A COUPLED THERMAL HYDRAULICS-POINT KINETICS DIGITAL COMPUTER CODE DESIGNED TO CALCULATE SIGNIFICANT REACTOR PARAMETERS UNDER STEADY-STATE CONDITIONS, OR AS FUNCTIONS OF TIME DURING TRANSIENTS. THE TRANSIENTS MAY RESULT FROM A PROGRAMMED REACTIVITY INSERTION OR A POWER CHANGE. VARIABLE INLET COOLANT FLOW RATE AND TEMPERATURE ARE CONSIDERED. THE CODE CALCULATES THE REACTOR POWER, THE INDIVIDUAL REACTIVITY FEEDBACKS, AND THE TEMPERATURE OF COOLANT, CLADDING, FUEL, STRUCTURE, AND ADDITIONAL MATERIAL FOR UP TO SEVEN AXIAL POSITIONS IN THREE CHANNEL TYPES WHICH REPRESENT RADIAL ZONES OF THE REACTOR. THE HEAT OF FUSION ACCOMPANYING FUEL MELTING, THE LIQUID METAL VOIDING REACTIVITY, AND THE SPATIAL AND THE TIME VARIATION OF THE FUEL CLADDING GAP COEFFICIENT DUE TO CHANGES IN GAP SIZE ARE CONSIDERED.

187 PUMP IMPELLER DESIGN SYSTEM THIS SYSTEM HAS BEEN DEVELOPED FOR THE DESIGN AND DEVELOPMENT OF HIGH SPEED TURBOMACHINERY FOR PUMPING HIGH TEMPERATURE LIQUID METALS. AFTER INITIALING THE ANALYSIS AND DESIGN EFFORT BY ESTABLISHING THE PUMP CONDITIONS OF SERVICE THE CODES ARE USED TO DEFINE THE PUMP IMPELLER DESIGN. IN ALL PROGRAMS, REAL FLUID EFFECTS ARE NOT CONSIDERED. THE MACHINING CODE PRODUCES A PAPER TAPE FOR USE IN THE ACTUAL FABRICATION OF THE IMPELLER.

- 191 AX-TNT AX-TNT SOLVES
- (A) THE COUPLED HYDRODYNAMIC, THERMODYNAMIC AND NEUTRONIC EQUATIONS WHICH DESCRIBE A SPHERICAL, SUPER-PROMPT CRITICAL REACTOR SYSTEM DURING AN EXCURSION,
 - (B) THE COUPLED EQUATIONS OF MOTION, AND IDEAL GAS EQUATION OF STATE FOR THE DETONATION OF A SPHERICAL CHARGE IN A GAS.

R274 WIGL2 WIGL2 IS A ONE-DIMENSIONAL TWO-GROUP SPACE-TIME DIFFUSION THEORY PROGRAM WITH ZERO, ONE, OR SIX DELAYED NEUTRON GROUPS. THE PROGRAM WILL TREAT SLAB, CYLINDRICAL, AND SPHERICAL GEOMETRIES AND INCLUDES NON-BOILING HEAT TRANSFER. IT ACCOUNTS FOR XENON FEEDBACK AND FEEDBACK EFFECTS DUE TO FUEL AND COOLANT TEMPERATURE. CONTROL ROD MOTION AND CONTROL SYSTEM FEEDBACK BASED ON TOTAL CORE POWER OR OUTLET COOLANT TEMPERATURE CAN BE SIMULATED. TRANSIENTS MAY BE EXCITED BY PRESCRIBED CHANGES IN INLET COOLANT TEMPERATURE, COOLANT FLOW RATE, OR ROD POSITION.

G. RADIOLOGICAL SAFETY, HAZARD AND ACCIDENT ANALYSIS

12/67

47 CLOUD THE CLOUD PROGRAM CALCULATES THE EXTERNAL GAMMA-RAY DOSE RATE AND TOTAL INTEGRATED DOSE RESULTING FROM THE CONTINUOUS RELEASE OF RADIOACTIVE MATERIALS TO THE ATMOSPHERE.

172 AISITE2/R153 AISITE2 IS LARGELY BASED ON METHODS PROPOSED BY THE AEC IN TID-14844 BUT DIFFERS IN CERTAIN OF THE ASSUMPTIONS AND MODELS. THE CODE AUTOMATICALLY VARIES ANY ONE OF 46 PARAMETERS SUCH AS REACTOR POWER, BUILDING LEAK RATE, IODINE CLEAN-UP RATE, AND HALOGEN FILTER EFFICIENCY, COMPUTING THE EXCLUSION AREA, AND LOW POPULATION BOUNDARY ZONES AS FUNCTIONS OF THAT PARAMETER. THE EDIT INCLUDES DOSE VS. DISTANCE DATA, FRACTIONAL CONTRIBUTION BY ISOTOPE GROUP TO THE INHALATION DOSE, AND CRITICAL DISTANCES PROVIDING BOTH PRINTED AND GRAPHICAL DATA. THREE MODELS ARE AVAILABLE FOR FISSION PRODUCT RELEASE WITH UP TO 4 LEVELS OF CONTAINMENT.

196 CURIE/DOSE/THUNDERHEAD CURIE CALCULATES THE FISSION PRODUCT INVENTORY PRODUCED IN A REACTOR DURING CONSTANT POWER OPERATION AND RELEASES DIFFERENT PERCENTAGES OF THE NOBLE GASES, HALOGENS, AND PARTICULATES TO THE ATMOSPHERE AT REACTOR SHUTDOWN. DOSE CALCULATES THE TOTAL DOSE TO 13 INTERNAL BODY ORGANS RESULTING FROM INHALATION OF THE PASSING RADIOACTIVE CLOUD. THUNDERHEAD CALCULATES THE EXTERNAL CLOUD GAMMA EXPOSURE DOSE FROM THE RELEASED FISSION PRODUCTS.

200 SATURATED BLOWDOWN1 CALCULATION OF LOCAL PRESSURES, MASS FLOW RATES, FLUID QUALITIES, SPECIFIC VOLUMES, TEMPERATURES AND LOCAL HEAT TRANSFER COEFFICIENTS AT WETTED WALLS, DURING BLOWDOWN OF THE REACTOR PRIMARY COOLANT LOOP.

228 PRECON THE PURPOSE OF THE PROGRAM IS TO DETERMINE, FOR A GAS-COOLED REACTOR, THE CONTAINMENT PRESSURE AS A FUNCTION OF TIME, AFTER RUPTURES HAVE BEEN ASSUMED TO OCCUR IN THE PRIMARY SYSTEM OR IN CONJUNCTION WITH STEAM GENERATOR RUPTURES.

229 ELBOW DEFLECTIONS, RESTRAINT FORCES AND STRESSES ARE DETERMINED IN A FUEL ELEMENT SUBJECTED TO ASYMMETRIC POWER GENERATION, CIRCUMFERENTIALLY NON-UNIFORM COOLANT TEMPERATURE DISTRIBUTION, AND ASYMMETRIC FAST NEUTRON FLUX DAMAGE.

261 GADOSE/DOSET THE GADOSE PROGRAM CALCULATES RADIOACTIVITY AND DOSES RESULTING FROM INSTANTANEOUS ACCIDENTAL RELEASE OF ACTIVITY WHILE THE COMPANION PROGRAM DOSET INCLUDES THE EFFECTS OF A TIME-DEPENDENT ACCIDENTAL FISSION PRODUCT RELEASE FOR THE HTGR TYPE OF PLANT. GIVEN AN INITIAL FISSION PRODUCT INVENTORY RELEASED INTO A REACTOR VESSEL OR CONTAINMENT VOLUME, THE QUANTITY OF EACH ISOTOPE IS CALCULATED AT A NUMBER OF TIMES AT A NUMBER OF LOCATIONS (IN THE CONTAINMENT, CONTAINMENT RECIRCULATING CLEANUP FILTERS, LEAK COLLECTOR, PLANT EXHAUST FILTERS AND IN THE ATMOSPHERE AT A NUMBER OF DISTANCES FROM THE PLANT). EACH DECAY CHAIN IS CALCULATED SEPARATELY CONSIDERING BUILDUP AND DECAY OF EACH ISOTOPE. RADIOLOGICAL DOSES ARE CALCULATED FOR ANY THREE BODY ORGANS AND THE WHOLE BODY BASED ON METEOROLOGICAL AND PHYSIOLOGICAL INPUT PARAMETERS. FALLOUT AND RAINOUT ARE INCLUDED.

265 RSAC/DEP RSAC IS USED TO COMPUTE THE POTENTIAL RADIOLOGICAL DOSES RESULTING FROM EITHER A CONTINUOUS OR INSTANTANEOUS RELEASE OF RADIOACTIVE FISSION PRODUCTS TO THE ATMOSPHERE. THE DOSES CONSIDERED ARE CLOUD GAMMA, DEPOSITION GAMMA, INGESTION, AND INHALATION BASED UPON THE RELEASE OF UP TO 200 ISOTOPES, THE RELATIVE ABUNDANCE OF EACH ISOTOPE DEPENDENT UPON THE OPERATING HISTORY OF THE REACTOR. EFFECTS OF NEUTRON ACTIVATION ARE NEGLECTED BUT IF KNOWN, CAN BE ADDED TO THE FISSION YIELDS.

268 TRANS-FUGUE1 TRANS-FUGUE1 IS A TRANSIENT SINGLE CHANNEL, TWO-PHASE FLOW, AND HEAT TRANSFER CODE FOR ANALYSIS OF POSTULATED REACTOR INCIDENTS INVOLVING BOILING. THE CODE IS BASED ON A HOMOGENEOUS HYDRODYNAMIC MODEL WHICH ASSUMES EQUAL PHASE TEMPERATURES AND VELOCITIES. IT ASSUMES VAPOR GENERATION TO BE HEAT TRANSFER LIMITED ONLY, AND CALCULATES AXIAL DISTRIBUTION OF VELOCITY, VOID FRACTION, PRESSURE, COOLANT TEMPERATURE, AND FUEL TEMPERATURE. TRANSIENTS SIMULATING POWER EXCURSIONS, LOSS OF FLOW, LOSS OF PRESSURE AND CHANNEL PLUGGING CAN BE STUDIED.

278 WATER-HAMMER THE PROGRAM ANALYZES HYDRAULIC TRANSIENTS IMPOSED BY THE SUDDEN DISCHARGE OF LIQUID FROM THE PRIMARY COOLANT LOOP, BEFORE ANY GENERATION OF VAPOR HAS TAKEN PLACE. EFFECTS OF HYDRAULIC LOSSES ARE NEGLECTED, THE LOOP PRESSURIZER IS ASSUMED TO REMAIN CONSTANT AT INITIAL PRESSURE AND THE PRESENCE OF A PUMP IS IGNORED. IT WAS DESIGNED FOR THE EARLY BLOWDOWN ANALYSIS FOR LOFT.

H. STEADY-STATE AND TRANSIENT HEAT TRANSFER

12/67

152 ARGUS (RE248) THIS PROGRAM CALCULATES TRANSIENT TEMPERATURES IN A CONCENTRIC, CYLINDRICAL CONFIGURATION. UP TO 25 CONCENTRIC REGIONS ARE ALLOWED, EACH CONTAINING EITHER A STATIONARY (SOLID OR NON-FLOWING LIQUID) OR TURBULENTLY FLOWING (LIQUID OR GAS) MATERIAL. ANY STATIONARY REGION CAN HAVE SPATIAL- AND TIME-DEPENDENT HEAT GENERATION. TEMPERATURES ARE CALCULATED AT NODE POINTS EQUALLY-SPACED WITHIN A REGION. FILM COEFFICIENTS ON FLOWING REGION BOUNDARIES ARE CALCULATED BY THE PROGRAM. TIME-DEPENDENT COOLANT VELOCITIES ARE PERMITTED. THE HEAT SOURCE IS ASSUMED TO BE ANGULAR INDEPENDENT. AXIAL HEAT CONDUCTION IS NEGLECTED, BUT AXIAL HEAT TRANSPORT DUE TO MATERIAL MOTION IS CONSIDERED IN THE FLOWING REGIONS.

155 PTH1 THIS PROGRAM CALCULATES CONTAINMENT SHELL PRESSURE-TEMPERATURE HISTORY RESULTING FROM AQUEOUS COOLANT SYSTEM BLOWDOWN.

182 AXFLU AXFLU CALCULATES HEAT TRANSFER FROM A LATTICE OF FLUID CYLINDRICAL FUEL PINS TO COOLANT IN EITHER SLUG OR FULLY-DEVELOPED LAMINAR FLOW. SOLUTION IS ANALYTIC AND CLOSED, EXCEPT FOR SATISFYING BOUNDARY CONDITIONS AT A FINITE, (BUT ARBITRARY), NUMBER OF BOUNDARY POINTS.

183 AXTHRM AXTHRM CALCULATES HEAT TRANSFER FROM A TRIANGULAR LATTICE OF CLAD SOLID CYLINDRICAL FUEL PIN TO COOLANT IN EITHER SLUG OR FULLY-DEVELOPED LAMINAR FLOW. SOLUTION IS ANALYTIC AND CLOSED, EXCEPT FOR SATISFYING BOUNDARY CONDITIONS AT A FINITE, (BUT ARBITRARY), NUMBER OF BOUNDARY POINTS.

198 HEATING2 HEATING2 IS A GENERALIZED HEAT TRANSFER CODE CAPABLE OF SOLVING TRANSIENT AND/OR STEADY-STATE COORDINATE SYSTEMS. THE SIMPLIFIED INPUT MAKES IT A VERY USEFUL CODE FOR THOSE PROBLEMS HAVING GEOMETRICAL CONFIGURATIONS WHICH CAN BE DESCRIBED BY PARALLEL AND PERPENDICULAR LINES OR PLANES, OR CONCENTRIC CIRCLES. THESE FIGURES CAN BE BROKEN UP INTO A MAXIMUM OF 100 ONE-MATERIAL REGIONS WITH POSITION AND TIME-DEPENDENT VOLUMETRIC HEAT GENERATION RATES. UP TO 40 MATERIALS WITH CONSTANT PROPERTIES CAN BE DESCRIBED, AND THE INITIAL TEMPERATURES OF THESE REGIONS ARE POSITION-DEPENDENT. THE BOUNDARIES OF THESE REGIONS CAN BE CONTACT, INSULATED, TIME-DEPENDENT TEMPERATURE CONTROLLED, OR FORCED CONVECTION WITH A TIME-DEPENDENT SINK TEMPERATURE. ALSO A RADIATION BOUNDARY WITH A TIME-DEPENDENT SINK TEMPERATURE IS INCLUDED.

205 BLCOST5 BLCOST5 COMBINES A REACTOR KINETICS CODE WITH A TWO-DIMENSIONAL HEAT TRANSFER CODE, AND IS APPLICABLE TO PROBLEMS FOR WHICH THE SPACE-INDEPENDENT FORM OF THE REACTOR KINETICS EQUATION IS APPLICABLE.

242 RATH MESHER/RATH WANTON THESE CODES SOLVE THE TWO- AND THREE-DIMENSIONAL HEAT CONDUCTION PROBLEM IN GENERAL GEOMETRIES. TIME, TEMPERATURE, AND POSITION-DEPENDENT PHYSICAL PROPERTIES CAN BE USED.

246 FLOW-MODEL A MULTI-CHANNEL, TWO-DIMENSIONAL, TWO-PHASE FLOW MODEL, DESIGNED TO COMPUTE THE AXIAL AND RADIAL COOLANT DENSITY AND QUALITY PROFILES, THE AXIAL PRESSURE PROFILE AND THE WEIGHT FLOW DISTRIBUTION FOR AN OPEN MATRIX FLOW, BOILING WATER REACTOR.

256 MANTA MANTA IS A PROGRAM WHICH PROVIDES A THERMAL-HYDRAULIC NODAL ANALYSIS IN THE STEADY STATE. IT WAS DESIGNED TO ANALYZE FUEL ELEMENT CONFIGURATION IN THE SUPER-HEAT DEVELOPMENT PROGRAM. MANTA ANALYZES MIXING BETWEEN COOLANT CHANNELS, ALLOWS FOR TEMPERATURE VARIANT CONDUCTIVITY IN ADMITTANCE CALCULATION, AND MULTIPLE STACKED SEGMENTS THROUGH THE FUEL REGION FOR A 7 ELEMENT CLUSTER ANALYSIS OVER A LENGTH OF UP TO 8 FEET. MANTA IS DESIGNED FOR SINGLE-PASS STEAM FLOW. THE FLOW DIRECTION IN THE COOLANT CHANNELS MAY BE EITHER UP OR DOWN, THEREBY PERMITTING THE ANALYSIS OF TWO-PASS AS WELL AS SINGLE-PASS FUEL ELEMENTS. MANTA ACCOUNTS FOR THE HEAT TRANSFER AND PRESSURE DROP THAT MAY OCCUR BETWEEN COOLANT CHANNELS DUE TO MIXING AS WELL AS TO THE CONVENTIONAL HEAT TRANSFER AND PRESSURE DROP RELATIONSHIPS DUE TO FRICTION, DISCONTINUITIES, ACCELERATION, CONVECTION, CONDUCTION, AND RADIATION. MANTA ALLOWS FOR THE CALCULATION AT EACH NODE OF THE MATERIAL PROPERTIES VISCOSITY, SPECIFIC HEAT, CONDUCTIVITY, AND SPECIFIC VOLUME TO CORRESPOND TO THE ACTUAL NODE TEMPERATURE BEING SOLVED FOR.

R267 WATER WATER IS A SUBROUTINE USED TO EXTRACT THERMODYNAMIC AND TRANSPORT PROPERTIES OF LIQUID, VAPOR, AND SUPERCRITICAL WATER BY TABULAR INTERPOLATION OVER THE RANGE OF STATES - 14.5 TO 14,500 PSIA AND 32 TO 1472 DEGREES F. THESE PROPERTIES ARE SPECIFIC VOLUME, SPECIFIC ENTHALPY, DYNAMIC VISCOSITY, AND THERMAL CONDUCTIVITY, TABULATED FOR PRESSURE AND TEMPERATURE CONDITIONS.

R272 FIGRO FIGRO CALCULATES THE ONE-DIMENSIONAL STEADY-STATE TEMPERATURE DISTRIBUTION AND TOTAL FUEL SWELLING FOR METAL-CLAD, AXISYMMETRIC, BULK-OXIDE CYLINDRICAL FUEL ELEMENTS. THE FUEL PELLET MAY BE SOLID, ANNULAR, OR CONTAIN TWO RADIAL ZONES. OXIDE FUEL THERMAL CONDUCTIVITY IS A FUNCTION OF TEMPERATURE, DEPLETION, AND POROSITY. FUEL SWELLING IS A FUNCTION OF TEMPERATURE, DEPLETION, INTERNAL HYDROSTATIC PRESSURE, AND FISSIIONING RATE. EITHER THE CLAD SURFACE FLUX OR THE TEMPERATURE AT THE INSIDE RADIUS OF THE FUEL MAY BE SPECIFIED AS A BOUNDARY CONDITION FOR THE HEAT CONDUCTION EQUATION.

I. DEFORMATION AND STRESS DISTRIBUTION COMPUTATIONS,
STRUCTURAL ANALYSIS AND ENGINEERING DESIGN STUDIES

12/67

48 FUGUE THE FUGUE PROGRAM COMPUTES STEADY-STATE WALL AND BULK FLUID TEMPERATURE, VOID FRACTION, AND LOCAL PRESSURE IN LIQUID-COOLED CLOSED CHANNELS IN WHICH THE HEATING RATE IS SPECIFIED. THE REQUIRED RELATIONSHIPS ARE EXPRESSED IN GENERAL, NON-DIMENSIONAL FORM AND COMBINED IN AN INTERNALLY CONSISTENT MANNER TO ALLOW PREDICTIONS FOR A VARIETY OF COOLANTS AND SPECIFIED OPERATING CONDITIONS.

109 4RESTRAINT PIPE STRESS CODE THIS PROGRAM EVALUATES A FOUR RESTRAINT PIPING SYSTEM DESIGNED FOR HIGH TEMPERATURE OPERATION.

112 CROCK CROCK SELECTS THE MINIMUM WEIGHT DESIGN FOR A SPACE POWER PLANT IN WHICH THE WASTE CYCLE HEAT IS RADIATED DIRECTLY TO SPACE FROM THE CONDENSER. IT ACCOUNTS FOR HEAT TRANSFER, FLUID FLOW, METEOROID PROTECTION, AND THE GEOMETRIC PROPERTIES OF A RADIATOR-CONDENSER.

114 SHOCK SHOCK SELECTS THE MINIMUM WEIGHT DESIGN FOR A HEAT-REJECTION SYSTEM FOR A SPACE POWER PLANT IN WHICH THE SENSIBLE HEAT LOST FROM A SINGLE-PHASE FLUID IS RADIATED TO SPACE. IT ACCOUNTS FOR HEAT TRANSFER, FLUID FLOW, METEOROID PROTECTION AND RADIATOR GEOMETRY.

190 WOPEXPRT THE PURPOSE OF THE CODE IS TO CHOOSE THE LIGHTEST REACTOR RESULTING FROM ALL POSSIBLE COMBINATIONS OVER THE RANGE OF REACTOR INDEPENDENT VARIABLES SPECIFIED. THE ENGINEERING CALCULATIONS FOR EACH REACTOR DESIGN ARE BASED ON A LIQUID-COOLED CYLINDRICAL REACTOR HAVING PIN-TYPE FUEL ELEMENTS. REACTOR CONTROL IS ASSUMED TO BE EFFECTED BY MOVABLE SIDE REFLECTORS SURROUNDING THE CORE. NECESSARY PHYSICS DATA IS INPUT IN THE FORM OF SECOND-DEGREE EQUATIONS AS A FUNCTION OF THE INDEPENDENT VARIABLES.

230 PIZZA THIS CODE USES A NUMERICAL METHOD TO CALCULATE THE DEFORMATION AND RESULTING STRESS DISTRIBUTION OF TWO-DIMENSIONAL BODIES UNDER PLANE STRESS CONDITIONS. PIZZA IS INTENDED AS A RAPID AND FLEXIBLE DESIGN TOOL IN WHICH THE MATERIAL CONSTANTS, DIMENSIONS, AND LOADING CONDITIONS MAY BE READILY ALTERED. THIS CODE IS PARTICULARLY APPLICABLE TO THE SOLUTION OF IRREGULARLY-SHAPED PLANE BODIES WHICH DO NOT HAVE EITHER AN EXACT OR AN APPROXIMATE MATHEMATICAL SOLUTION.

232 GAZELLES DETERMINATION OF GAS-COOLED FAST REACTOR CORE PROPORTIONS REQUIRED TO SATISFY SPECIFIED DESIGN CONSTRAINTS AND COMPUTATION OF RESULTING PERFORMANCE CHARACTERISTICS.

233 CORE THE REACTOR CORE CONFIGURATION DESIGNED BY THE CORE PROGRAM CONSISTS OF CYLINDRICAL FUEL ELEMENTS ARRANGED ON AN EQUILATERAL PITCH SPACING WITH INTERNAL AND EXTERNAL COOLING. THE FUEL ELEMENT IS COMPOSED OF THREE CONCENTRIC GRAPHITE RINGS, AN INTERNAL COOLANT CHANNEL, AND A SPINE. THE COOLANT CHANNEL IS FORMED BY THE SPINE AND INNER GRAPHITE RING. THE FUEL IS CONTAINED IN THE MIDDLE GRAPHITE RING. CORE WILL DETERMINE THE NUMBER OF FUEL ELEMENTS OF A SPECIFIED DIAMETER AND LENGTH REQUIRED TO SATISFY A GIVEN CENTRAL FUEL TEMPERATURE. IT ALSO ADJUSTS THE PITCH SPACING REQUIRED TO PRODUCE A DESIRED PRESSURE DROP AS WELL AS PROVIDING A SPECIFIED INTERNAL COOLING RATE.

244 CYCLOPS1 CYCLOPS1 IS A PROGRAM FOR THE ANALYSIS OF THERMODYNAMIC SYSTEMS. IT IS A GENERAL PURPOSE PROGRAM THAT PERFORMS A HEAT AND MASS BALANCE FOR THERMODYNAMIC SYSTEMS COMPOSED OF PUMPS, TURBINES, SEPARATORS, HEAT EXCHANGERS, COMPRESSORS AND FLOW THROTTLING DEVICES. THESE COMPONENTS MAY BE CONNECTED IN ANY DESIRED WAY. THE THERMODYNAMIC FLUIDS THAT MAY BE USED ARE WATER, AIR, NITROGEN, AND PARA-HYDROGEN.

250 SAFE-PCRS SAFE-PCRS NUMERICALLY DETERMINES THE STRESS AND STRAIN DISTRIBUTION WITHIN EITHER HOMOGENEOUS OR HETEROGENEOUS THICK-WALLED BODIES OF REVOLUTION. IT IS DESIGNED FOR THE ANALYSIS OF MULTI-MATERIAL AXISYMMETRIC COMPOSITE STRUCTURES SUCH AS REINFORCED AND/OR PRESTRESSED CONCRETE VESSELS. DEFORMATIONS MUST BE WITHIN THE ELASTIC LIMIT OF THE MATERIALS CONSIDERED AND ONLY BODIES OF REVOLUTION SUBJECTED TO AXISYMMETRIC LOADING CAN BE TREATED.

251 SAFE-AXISYM SAFE-AXISYM IS A PROGRAM FOR THE ANALYSIS OF MULTI-MATERIAL AXISYMMETRIC COMPOSITE STRUCTURES. IT IS DESIGNED FOR THE ANALYSIS OF HETEROGENEOUS STRUCTURES SUCH AS REINFORCED AND/OR PRESTRESSED CONCRETE VESSELS. THE STRUCTURE IS ASSUMED TO BE LINEARLY ELASTIC, AND ONLY BODIES OF REVOLUTION SUBJECTED TO AXISYMMETRIC LOADING CAN BE TREATED.

252 SAFE-PLANE SAFE-PLANE IS APPLIED TO TWO-DIMENSIONAL STRUCTURES OF ARBITRARY GEOMETRY UNDER IN-PLANE LOADS. EITHER PLANE STRESS OR PLANE STRAIN CONDITIONS MAY BE IMPOSED. MECHANICAL AND/OR THERMAL LOADS ARE PERMITTED.

253 SAFE-SHELL SAFE-SHELL IS USED TO DESIGN AND ANALYZE AXISYMMETRIC THIN SHELL STRUCTURES OF ARBITRARY GENERATRICES UNDER AXISYMMETRIC MECHANICAL AND/OR THERMAL LOADING CONDITIONS. THE INTERSECTION OF TWO OR MORE SHELLS CAN BE TREATED.

R266 CYGRO2

CYGRO2 IS USED TO DETERMINE STRESSES AND STRAINS DURING STEADY-STATE AND TRANSIENT POWER OPERATION OF AN OXIDE-FUELED, METAL CLAD ROD-TYPE FUEL ELEMENT IN A PRESSURIZED ENVIRONMENT. MAJOR LOADING CONDITIONS INCLUDE FUEL SWELLING, FISSION GAS AND COOLANT PRESSURE, CLAD GROWTH AND DIFFERENTIAL THERMAL EXPANSION. THE APPLICATION FOR WHICH THE PROGRAM HAS BEEN DEVELOPED IS ZIRCALOY TUBES CONTAINING BULK OXIDE FUEL. AXIAL AND AZIMUTHAL SYMMETRY OF TEMPERATURE AND STRESSES IS ASSUMED.

J. GAMMA HEATING AND SHIELD DESIGN PROBLEMS

12/67

45 GRACE1 GRACE1 IS A MULTIGROUP, MULTIREGION, GAMMA-RAY ATTENUATION PROGRAM DESIGNED PRIMARILY FOR COMPUTING GAMMA-RAY HEATING AND GAMMA-RAY DOSE RATES IN MULTIREGION FINITE OR SEMI-INFINITE SLAB SHIELDS. A DIFFERENT BUILDUP FACTOR MAY BE SPECIFIED FOR EACH SOURCE REGION CONSIDERED.

46 GRACE2 GRACE2 IS A MULTIGROUP, MULTIREGION, GAMMA-RAY ATTENUATION PROGRAM TO COMPUTE THE TOTAL DOSE RATE OR HEAT GENERATION RATE FROM EITHER A SPHERICAL OR A CYLINDRICAL SOURCE. THE SOURCE, WHICH MAY BE LOCATED IN EITHER THE CENTRAL REGION OF THE SYSTEM OR IN A CONCENTRIC SHELL REGION SURROUNDING IT, MAY BE UNIFORM, EXPONENTIAL, OR HAVE A POLYNOMIAL VARIATION IN THE RADIAL DIRECTION. IN THE CASE OF CYLINDRICAL GEOMETRY, IT MAY ALSO HAVE A POLYNOMIAL VARIATION IN THE AXIAL DIRECTION.

91 FARSE1A THE PROGRAM COMPUTES THE NEUTRON LEAKAGE FROM A SHIELD ANNULUS. THE REMOVAL CROSS SECTIONS INCORPORATE MULTISCATTERING EFFECTS. DOSE DEPOSIT AT THE TARGET MESH IS THEN DETERMINED FROM THE ANGULAR DISTRIBUTION OF THE LEAKAGE NEUTRONS, INTEGRATED OVER THE SHIELD SURFACE.

110 SCARF2 SCARF2 EVALUATES THE FIRST-ORDER APPROXIMATION OF THE FAST NEUTRON CURRENT AT THE PAY LOAD SURFACE DUE TO NEUTRONS WHICH SCATTER FROM THE RADIATOR FINS. IT USES SNAP GEOMETRY AND IS A COMPLEMENTARY PROGRAM TO FARSE.

111 SCAR1 SCAR1 PERFORMS SINGLE SCATTER RAY TRACING AND EVALUATES SCATTERING FROM A RING. IT IS COMPLEMENTARY TO FARSE.

123 LIPRECAN1 LIPRECAN1 IS A TWO-DIMENSIONAL MONTE CARLO PROGRAM TO COMPUTE THE PENETRATION AND ENERGY DEPOSITION OF NEUTRONS IN PURE HYDROGENOUS MEDIA. THE CODE OFFERS THREE POSSIBLE GEOMETRIES, I. E., CONICAL, CYLINDRICAL AND ONE-DIMENSIONAL INFINITE SLAB GEOMETRY (THIS LATTER OPTION TO THE EXTENT THAT AN INFINITE SLAB MAY BE APPROXIMATED BY A CYLINDER OF LARGE RADIUS). THE CODE MAY BE USED WITH A MONO-DIRECTIONAL POINT OR BEAM SOURCE AND IS MODIFIED EASILY TO HANDLE ANGULAR DISTRIBUTIONS. ISOTROPIC SCATTERING IN THE CENTER OF MASS SYSTEM IS ASSUMED. THE FOLLOWING RESULTS ARE TABULATED WITH EACH SUMMARY -

- (A) ENERGY DEPOSITION DISTRIBUTION,
- (B) PARTICLE DEPOSITION DISTRIBUTION,
- (C) PARTICLE LEAKAGE FRACTION,
- (D) PARTICLE ABSORPTION FRACTION,
- (E) THE FRACTION OF PARTICLES REACHING THE CUTOFF ENERGY WHICH HAVE NEITHER LEAKED NOR HAVE BEEN ABSORBED,
- (F) THE AVERAGE ENERGY PER PARTICLE LEAKING FROM THE SYSTEM,
- (G) THE AVERAGE ENERGY PER PARTICLE REMAINING IN THE SYSTEM AS HEAT GENERATION,
- (H) THE AVERAGE NUMBER OF COLLISIONS PER HISTORY,
- (I) THE TOTAL NUMBER OF HISTORIES CURRENTLY BEING SUMMARIZED,
- (J) THE AVERAGE ENERGY DEPOSIT PER HISTORY THROUGH ABSORPTION,
- (K) THE AVERAGE ENERGY OF PARTICLES ABSORBED.

141 RATRAP THE RATRAP PROGRAM COMPUTES THE DOSE RATE AT SPECIFIED SPATIAL POINTS ABOUT A SYSTEM OF SNAP GEOMETRY.

142 MORTIMER MORTIMER COMPUTES THE DOSE RATE AT SPECIFIED SPATIAL POINTS ABOUT A SYSTEM OF SNAP GEOMETRY.

143 MAC MAC PERFORMS SLAB GEOMETRY, MULTIGROUP NEUTRON AND GAMMA RAY PENETRATION ANALYSIS FOR A MULTI-REGION REACTOR SHIELD. THE CODE CALCULATES THE FOLLOWING INFORMATION AS A FUNCTION OF DISTANCE THROUGH A REACTOR SHIELD ASSEMBLY -
 NEUTRON FLUXES FOR UP TO 35 ENERGY GROUPS,
 NEUTRON DOSE RATES,
 THE APPROXIMATE NEUTRON SPECTRUM,
 GAMMA RAY FLUXES FOR 7 ENERGY GROUPS,
 TOTAL GAMMA DOSE RATE, WITH A BREAKDOWN OF THE CONTRIBUTION FROM SOURCES IN EACH REACTOR AND SHIELD REGION,
 THE APPROXIMATE GAMMA RAY SPECTRUM.

197 SHOE THE SHOE CODE MAKES USE OF THE METHOD OF STEEPEST DESCENT TO FIND THE DIMENSIONS OF A MINIMUM-WEIGHT, THREE-LAYER SHIELD IN SPHERICAL GEOMETRY. THE WEIGHT MINIMIZATION IS CARRIED OUT SUBJECT TO THE CONSTRAINING CONDITION OF A CONSTANT DOSE RATE AT SOME SELECTED POINT OUTSIDE THE SHIELD.

259 MUSCAT MUSCAT COMPUTES THE INCIDENT SCATTERED NEUTRON CURRENTS AS A FUNCTION OF POSITION WITHIN (1) THE CAVITY FORMED BY TWO TRUNCATED CONCENTRIC SPHERES, (2) THE CAVITY BETWEEN TWO CONCENTRIC CIRCULAR CYLINDERS, OR (3) A CYLINDRICAL CAVITY.

K. TOTAL SYSTEMS ANALYSIS

12/67

273 THREDES

THREDES IS A SCIENTIFIC APPLICATIONS PROGRAMMING SYSTEM. INCORPORATED IN THIS SYSTEM ARE THE NECESSARY MODULES TO PERFORM PARAMETRIC DESIGN STUDIES OF THERMAL REACTORS INCLUDING THE THERMAL CELL HOMOGENIZATION (BAM - ACC ABSTRACT 108), THE FAST SPECTRUM CALCULATION (FORM - ACC ABSTRACT 51), REACTOR DIFFUSION THEORY (FOG - ACC ABSTRACT 28), AND ZERO-DIMENSIONAL BURNUP (KINDLE) CALCULATIONS. THESE MODULES CAN BE USED IN CONJUNCTION WITH ONE ANOTHER OR INDIVIDUALLY.

L. DATA PREPARATION

12/67

189 SNC
FOR DSN AND TDC.

CALCULATION OF SN CONSTANTS

193 CSP2A THIS CODE PREPARES 100 GROUP FORWARD AND ADJOINT MACROSCOPIC MIXTURE CROSS SECTIONS FOR SN TYPE CODES. THE 100 GROUP MICROSCOPIC CROSS SECTIONS ARE TAKEN FROM THE CROSS SECTION TAPE WRITTEN BY THE CODE CSP1. THE OUTPUT OF CSP2A IS IN THE FORM OF TWO TAPES, ONE CONTAINING THE FORWARD AND THE OTHER THE ADJOINT MACROSCOPIC CROSS SECTIONS. THE CROSS SECTIONS ARE ALSO PRINTED, IF DESIRED.

194 CSPI THIS CODE PREPARES 100 GROUP MICROSCOPIC CROSS SECTIONS FOR SN TYPE REACTOR CODES, USING THE GAM2 NUCLEAR DATA TAPE FOR THE CROSS SECTION DATA FOR THE FIRST 99 GROUPS. THE DATA FOR GROUP 100 IS PART OF THE PUNCHED CARD INPUT. THE 100 GROUP SN CROSS SECTIONS, PREPARED BY THE CODE, ARE WRITTEN ON TAPE AND PRINTED, IF DESIRED. THE CROSS SECTIONS ARE FOR THE ISOTROPIC OPTION OF THE SN CODES. THE DIAGONAL TRANSPORT APPROXIMATION HAS BEEN USED IN CALCULATING THE TRANSPORT AND IN-GROUP SCATTERING CROSS SECTIONS. THE CORRECTION TERM USED TO CALCULATE THESE TWO CROSS SECTIONS IS SIMPLY $1/3$ OF THE P_1 SCATTERING CROSS SECTION. THE NUMBER OF OUT-OF-GROUP SCATTERING TERMS IS OPTIONAL. WHEN LESS THAN THE NUMBER APPEARING ON THE GAM2 TAPE ARE REQUESTED, THE REMAINING TERMS, FOR A GIVEN SOURCE GROUP, ARE SUMMED AND ADDED TO THE LAST DOWN-SCATTERING TERM SAVED. WHEN CROSS SECTIONS ARE LISTED IN THE SN FORMAT, IT IS POSSIBLE THAT ONE OR MORE INTERMEDIATE DOWN-SCATTERING TERMS WILL BE ZERO. WHEN THIS SITUATION ARISES, THE CODE WILL REPLACE THESE INTERMEDIATE ZEROS WITH THE QUANTITY 1.0×10^{-20} .

218 GAVR GAVR CALCULATES GROUP AVERAGED CROSS SECTIONS FROM POINTWISE CROSS SECTIONS DATA FOR THE GAM2 99 FINE-GROUP LIBRARY. THE INPUT DATA ARE USED TO OBTAIN A SET OF INTERPOLATED CROSS SECTIONS, WHERE 20 INTERPOLATED CROSS SECTIONS ARE OBTAINED FOR EACH FINE GROUP. WHERE INPUT DATA DO NOT COVER THE FULL RANGE OF A FINE GROUP, THE GROUP-AVERAGED CROSS SECTION IS SET TO ZERO.

234 DPC DPC PREPARES INPUT DATA
FOR TWO-DIMENSIONAL NEUTRONIC CALCULATIONS FROM ENGINEERING DATA.
A GENERAL DESCRIPTION OF REGIONS, IN TERMS OF MULTIPLE SUBREGIONS,
ALLOWS FOR EXPLICIT CONSIDERATION OF DETAILED STRUCTURAL FORMS.
DURING THE TRANSFORMATION OF DATA, GENERAL THERMAL EXPANSIONS ARE
INCLUDED. ALSO, CONSIDERABLE DATA CHECKING AND EVALUATION ARE
PERFORMED. COMBINED WITH THE FLEXIBLE NARRATIVE INPUT, THESE
FEATURES MAKE THE CODE USEFUL IN THE PREPARATION OF ERROR-FREE
INPUT FOR COMPLEX PROBLEMS.

M. DATA MANAGEMENT

12/67

159 MCMUS MCMUS IS THE PROGRAM USED TO CONSTRUCT AND MAINTAIN THE NEUTRON CROSS SECTION MASTER TAPE DEVELOPED UNDER THE ATOMICS INTERNATIONAL AUTOMATED CROSS SECTION PROGRAM. THE LIBRARY CONTAINS 21 ELEMENTS WITH DATA FOR 11 PARAMETERS IN THE RANGE 0.001 EV TO 10 MEV. MCMUS WILL PERFORM THE FOLLOWING TASKS -

- (A) MAKE THE BINARY MASTER TAPE FROM CARDS,
- (B) LIST SELECTED ELEMENTS,
- (C) UPDATE - ADD, CORRECT AND REPLACE ANY DATA,
- (D) MAKE A SHORT TAPE CONTAINING SELECTED ELEMENTS,
- (E) PROVIDE GRAPHICAL DISPLAY OF SELECTED DATA, AND
- (F) PUNCH MICROSCOPIC DATA.

181 XLIBIT USING THE ANL STANDARD CROSS SECTION DATA CARDS AS INPUT, THE PROGRAM CAN PERFORM THE FOLLOWING OPERATIONS -

- (A) PREPARE A LIBRARY TAPE CONSISTING OF THE CROSS SECTION DATA FOR SETS OF MATERIALS, INCLUDING A DIRECTORY GIVING THE SETS ON THE TAPE AND THE MATERIALS IN EACH SET,
- (B) GIVEN AN EXISTING LIBRARY TAPE, THE PROGRAM CAN PREPARE A DUPLICATE TAPE OR A MODIFIED TAPE, THE MODIFICATIONS CONSISTING OF THE ADDITION AND DELETION OF SETS, THE ADDITION AND DELETION OF MATERIALS WITHIN A SET, AND THE RE-ORDERING OF THE SETS ON THE TAPE,
- (C) ANY OF THE DATA ON A LIBRARY TAPE MAY BE PRINTED, AND THE PROGRAM WILL PUNCH THE CROSS SECTION DATA CARDS THAT WERE USED TO PLACE ANY OF THE MATERIALS OR SETS ON THE TAPE WITH ALTERED SET AND MATERIAL NAMES IF DESIRED.

206 UNPACK UNPACK RETRIEVES NEUTRON CROSS SECTION DATA AND RELATED INFORMATION FROM A SCISRS (BROOKHAVEN NATIONAL LABORATORY) DATA TAPE. THE FORMAT AND STRUCTURE OF THE SCISRS TAPE IS DESCRIBED IN BNL-883 BY FRIEDMAN AND PLATT, JULY 1964.

236 DFSR DATA FILE SERVICE ROUTINES (DFSR) ARE USED TO STORE, DISTRIBUTE, AND CHECK THE DATA ON THE EVALUATED NUCLEAR DATA FILE (ENDF). THERE ARE 6 ROUTINES -

- DFSR1 - STORES DATA ON MASTER LIBRARY TAPES.
- DFSR2 - PROCESSES REQUESTS FOR DATA BY FINDING THE APPROPRIATE DATA ON THE MASTER TAPES AND COPYING THEM ONTO THE REQUESTORS TAPE.
- DFSR3 - CORRECTS DATA ON THE MASTER TAPES.
- DFSR4 - COPIES/PRINTS/PUNCHES SELECTED DATA FROM THE MASTER TAPES.
- DFSR5 - PRINTS LIST OF DATA RECENTLY ADDED TO MASTER TAPES AND PREPARES A CROSS-REFERENCE LIST OF ALL DATA ON THE MASTER TAPES.
- DFSR6 - MAKES COPIES AND CHECKS THE MASTER TAPES.

271 CLIP CLIP IS THE CROSS SECTION LIBRARY PREPARATION AND MAINTENANCE PROGRAM FOR FORM AND THREDES.

N. SUBSIDIARY CALCULATIONS

12/67

133 WED THIS PROGRAM EDITS THE MAGNETIC TAPE PRODUCED BY W-DSN CALCULATING REACTION RATES BY ENERGY AND BY VOLUME WITH TOTALS. IT CAN ALSO PRODUCE REACTION RATES FOR FED-IN CROSS SECTIONS.

207 CROSSPLOT AUTOMATIC PLOTS ARE GENERATED
FROM NEUTRON CROSS SECTION DATA.

210 DTX THE DTX CODE CALCULATES EFFECTIVE MACROSCOPIC, HOMOGENEOUS, GROUP CROSS SECTIONS WHICH ARE SPACE-AVERAGED OVER THE FLUXES AND CURRENTS PRE-CALCULATED IN A ONE-DIMENSIONAL NEUTRON TRANSPORT CODE SUCH AS DTK OR DSN. ISOTROPIC AND ANISOTROPIC CROSS SECTIONS MAY BE INCLUDED.

239 CPS CPS PROVIDES A GRAPHICAL
MEANS OF COMPARING EXPERIMENTAL CROSS SECTION VALUES OBTAINED
FROM THE SCISRS LIBRARY TAPE WITH AN OPTION TO INCLUDE READING IN
NEW EXPERIMENTAL OR CALCULATED VALUES.

D. EXPERIMENTAL DATA PROCESSING

12/67

154 CROC90 THE CROC90 CODE WAS DEVELOPED FOR USE IN THE DATA REDUCTION OF OUT-OF-PILE FLUID FLOW EXPERIMENTS ON THE ML-1 FUEL ELEMENTS. THE CODE IS SPECIFICALLY DESIGNED TO EVALUATE FRICTION FACTORS, ENTRANCE AND EXIT COEFFICIENTS, AND ORIFICE CALIBRATIONS FROM HYDRODYNAMIC DATA OBTAINED FROM SINGLE PHASE EXPERIMENTAL FLUID FLOW TESTS IN AXIAL FLOW DUCTS.

164 BURP1 THE PROGRAM CALCULATES ABSOLUTE TOTAL EFFICIENCY FOR MONOENERGETIC GAMMA RAY INTERACTIONS IN CYLINDRICAL SCINTILLATION DETECTORS. THE ABSOLUTE TOTAL EFFICIENCY IS DEFINED AS THE FRACTION OF SOURCE GAMMAS WHICH INTERACT AT LEAST ONCE WITH THE CRYSTAL DETECTOR. CALCULATIONS ARE MADE FOR THE POINT ISOTROPIC SOURCE LOCATED ALONG THE AXIS OF SYMMETRY FOR SOLID CYLINDRICAL CRYSTALS, WITH OR WITHOUT A COAXIAL CYLINDRICAL WELL.

165 BURP2 THE PROGRAM CALCULATES THE ABSOLUTE TOTAL EFFICIENCY FOR MONOENERGETIC GAMMA RAYS INTERACTING IN CYLINDRICAL SCINTILLATION DETECTORS. THE ABSOLUTE TOTAL EFFICIENCY IS DEFINED AS THE FRACTION OF SOURCE GAMMAS WHICH INTERACT AT LEAST ONCE WITH THE CRYSTAL DETECTOR. CALCULATIONS ARE MADE FOR HOMOGENEOUS, ISOTROPIC CIRCULAR DISK OR CYLINDRICAL VOLUME SOURCES. SOURCES MUST BE SYMMETRICAL WITH THE AXIS OF SYMMETRY FOR SOLID CYLINDRICAL CRYSTALS, WITH OR WITHOUT A COAXIAL CYLINDRICAL WELL. SOURCE ABSORPTION AND SCATTERING MAY BE INCLUDED FOR VOLUME SOURCES.

166 BURP3 THE PROGRAM CALCULATES ABSOLUTE TOTAL EFFICIENCY FOR MONOENERGETIC GAMMA RAY INTERACTIONS IN CYLINDRICAL SCINTILLATION DETECTORS. THE ABSOLUTE TOTAL EFFICIENCY IS DEFINED AS THE FRACTION OF SOURCE GAMMAS WHICH INTERACT AT LEAST ONCE WITH THE CRYSTAL DETECTOR. CALCULATIONS ARE MADE FOR POINT ISOTROPIC SOURCES LOCATED BOTH ON AND OFF THE AXIS OF SYMMETRY FOR SOLID CYLINDRICAL CRYSTALS, WITH OR WITHOUT A COAXIAL CYLINDRICAL WELL. THE EFFICIENCIES FOR POINTS LOCATED AT SPECIFIED RADIAL OFF-AXIS POSITIONS, FOR A SINGLE AXIAL SOURCE-CRYSTAL DISTANCE, ARE NORMALIZED TO THE ON-AXIS EFFICIENCY FOR THE SAME AXIAL DISTANCE. THE ABSOLUTE EFFICIENCY FOR THE ON-AXIS POINT IS GIVEN.

169 BURP4 BURP4 CALCULATES THE PHOTO-FRACTION FOR MONOENERGETIC GAMMA RAYS INTERACTING IN SOLID CYLINDRICAL SCINTILLATION DETECTORS. PHOTO-FRACTION IS DEFINED AS THE FRACTION OF INTERACTING SOURCE GAMMAS THAT ARE TOTALLY ABSORBED (INCLUDING SECONDARIES) IN THE CRYSTAL. ISOTROPIC SOURCE GEOMETRIES ALLOWED ARE ISOTROPIC POINTS (ON OR OFF-AXIS), DISKS, CYLINDRICAL VOLUMES. ALLOWED MONODIRECTIONAL SOURCES, NORMAL TO CRYSTAL FACE, ARE NARROW BEAM COLLIMATED TO CRYSTAL AXIS, BROAD BEAM ILLUMINATING ENTIRE CRYSTAL FACE, AND COLLIMATED BEAM OF ANY SPECIFIED DIAMETER.

170 BURP5 BURP5 CALCULATES THE PHOTO-FRACTION FOR MONOENERGETIC GAMMA RAYS INTERACTING IN WELL-TYPE CYLINDRICAL SCINTILLATION DETECTORS. PHOTO-FRACTION IS DEFINED AS THE FRACTION OF INTERACTING SOURCE GAMMAS THAT ARE TOTALLY ABSORBED (INCLUDING SECONDARIES) IN THE CRYSTAL. ISOTROPIC SOURCE GEOMETRIES ALLOWED ARE ISOTROPIC POINTS (ON OR OFF-AXIS), DISKS, CYLINDRICAL VOLUMES. ALSO ALLOWS NARROW MONODIRECTIONAL BEAM COLLIMATED TO CRYSTAL AXIS, INCIDENT NORMAL TO WELL BOTTOM.

248 COINC COINCIDENCE COUNTING DATA ARE TREATED TO OBTAIN SPECIFIC DISINTEGRATION RATES, CHANNEL EFFICIENCIES AND COUNT RATES, WEIGHTED MEANS, AND ALL ASSOCIATED STANDARD ERRORS. CORRECTIONS ARE MADE FOR UNEQUAL DEADTIME LOSS IN EACH CHANNEL, COINCIDENCE RESOLVING TIME LOSSES, DECAY DURING COUNTING, DECAY FROM A REFERENCE TIME, AND BACKGROUND IN EACH OF THE THREE CHANNELS. INPUT VARIABLES INCLUDE SAMPLE IDENTIFICATION, START TIME FOR COUNTING, SAMPLE REFERENCE TIME, COUNTING INTERVAL, TOTAL NUMBER OF COUNTS IN TWO SINGLE CHANNELS AND ONE COINCIDENCE CHANNEL, AND NORMALIZING SAMPLE VOLUME. INPUT PARAMETERS CONSIST OF DEADTIMES OF EACH SINGLE CHANNEL, COINCIDENCE RESOLVING TIME FOR ALL THREE CHANNELS, DECAY CONSTANT, BACKGROUND COUNT RATE FOR ALL THREE CHANNELS, AND STANDARD ERRORS FOR EACH OF THE ABOVE PARAMETERS. OPTIONAL INPUT ALLOWS DATE, GROUP CLASSIFICATION, AND A 3-DIGIT USER CODE. OUTPUT CONTAINS CORRECTED SINGLE CHANNEL, COINCIDENCE, AND DISINTEGRATION RATES REFERRED TO START OF COUNT, SPECIFIC DISINTEGRATION RATE (COUNTS/SECOND/UNIT VOLUME OR WEIGHT) REFERRED TO REFERENCE TIME, WEIGHTED MEAN AND ERROR OF ANY NUMBER OF PROBLEMS IN A GROUP, EFFICIENCIES OF THE TWO INDEPENDENT DETECTOR CHANNELS, DATE, SUMMARY OF BACKGROUND VALUES USED, IDENTIFICATION NUMBER, COUNT START TIME, AND UPPER AND LOWER LIMIT (ONE STANDARD DEVIATION) OF EACH OF THE COMPUTED QUANTITIES.

258 EXPN - EXPN ANALYZES PULSED NEUTRON DATA USING THE GARELIS-RUSSEL TECHNIQUE (REFERENCE 1). BASICALLY THE CODE COMPUTES THE PROMPT DECAY CONSTANT, ALPHA, AND THE PARAMETER ($K \cdot \text{BETA}/L$) FROM EXPERIMENTAL DATA, WHICH IS DIRECTLY EXTRACTED FROM A TIME ANALYZER STORAGE MEMORY AND READ ONTO A PUNCHED PAPER TAPE. THE ALPHA-DETERMINATION PART OF THE CODE WAS ORIGINALLY OBTAINED UNDER THE NAME EXPLICIT FROM KNOLLS ATOMIC POWER LABORATORY BUT HAS SINCE BEEN MODIFIED. THE CODE PROVIDES OPTIONS FOR A PRE-BURST OR A POST-BURST BACKGROUND ANALYSIS. THAT IS, THE PARAMETERS ALPHA AND ($K \cdot \text{BETA}/L$) ARE OBTAINED USING A BACKGROUND MEASURED PRIOR TO THE BURST OR MEASURED AFTER THE BURST.

62 LOS ALAMOS LEAST SQUARES THIS PROGRAM PERFORMS LEAST SQUARES FITTING OF LINEAR OR NONLINEAR FUNCTIONS IN SEVERAL INDEPENDENT VARIABLES. THE PROGRAM WILL DETERMINE AN ESTIMATE OF A IN THE FUNCTION $Y=F(X,A)$ BY MINIMIZING THE SUM OF SQUARES. IN THE FUNCTION, X IS A VECTOR OF OBSERVED VARIABLES AND A IS A VECTOR OF PARAMETERS TO BE DETERMINED. IN THIS CONTEXT, A LINEAR FUNCTION IS ONE WHOSE PARTIAL DERIVATIVES WITH RESPECT TO THE ELEMENTS OF A ARE ALL INDEPENDENT OF A. A NONLINEAR FUNCTION HAS AT LEAST ONE OF THE ELEMENTS OF A APPEARING IN AT LEAST ONE OF THESE PARTIAL DERIVATIVES.

186 LAG1/LAG2 LAG IS A SINGLE PASS LOAD AND GO ASSEMBLER DESIGNED TO ACCEPT IBM7090 FLOCO II INSTRUCTIONS.

VII. KWIC INDEX

STANT CALC 0 TO 10 MEV	BNWL	1107	F4	RS PLT=	GAMTEC2, MULTI-GP CEA	185
FUSION SLAB CYL SPHERE	BNWL	1107	F4	RS P T=	HFN, 1-D MULTI-GP DIF	241
ESS ANALYSIS, 2-D BODIES	GA	1108	F4	RS P =	SAFE-PLANE, PLANE STR	252
ALYSIS THIN SHELLS	GA	1108	F4	RS P =	SAFE-SHELL, STRESS AN	253
MELTING COOE CAVITY GEOM	GA	1108	F4	RS P T=	MUSCAT, VIEW FACTOR S	259
CIDENT ANALYSIS COOE CALC	GA	1108	F4	RS T=	GADOSE/COSET, MTGR AC	261
ERING LAW CALCULATION	GA	1108	F4	RS P =	GASKET, THERMAL SCATT	263
ACH INELASTIC SCATTERING	CDC	1604	F63	RS P =	MAFEVER, FAUSER-FES+B	14
SIGN SLAB CYLINDER SPHERE	CDC	1604	F63	RS P T=	FCG, 1-D FEW-GP DIFFU	26
FFUSION SLAB CYL SPHERE	CDC	1604	F63	RS PLT=	AIM6, 1-D MULTI-GP CI	29
N FOR AIM AND FCG CODES	CDC	1604	F63	RS =	PERT, 1-D PERTURBATIO	30
P DIFFUSION XYZ GEOMETRY	CDC	1604	F63	RS P T=	WHIRLAWAY, 3-D 2-GRU	32
ECTRUM X-SECTION CALC	CDC	1604	F63	RS PLT=	GAM1, FAST NEUTRON SP	33
P DIFFUSION SLAB CYLINDER	CDC	1604	F63	RS P T=	2DGRAND, 2-D FEW-GRU	40
ENUATION SLAB GEOMETRY	CDC	1604	F63	RS P =	GRACE1, GAMMA-RAY ATT	45
ENUATION CYL SPHERE GEOM	CDC	1604	F63	RS P =	GRACE2, GAMMA-RAY ATT	46
RATE FROM A CLOUD	CDC	1604	F63	RS P =	CLOUD, GAMMA-RAY DOSE	47
TRON SPECTRUM X-SECTIONS	CDC	1604	F63	RS PLT=	TEMPEST2, THERMAL NEU	50
ECTRUM X-SECTION CALC	CDC	1604	F63	RS PLT=	FORM, FAST NEUTRON SP	51
1-GP S4 APPROXIMATION	CDC	1604	F63	RS =	S4 CYL CELL CODE, 1-D	52
P DIFFUSION DEPLETION	CDC	1604	F63	RS LT=	SIZZLE, 1-D MULTIGROU	56
DIFFUSION CYLINDER SLAB	CDC	1604	F63	RS P T=	EQUIPOISE3A, 2-D 2-GP	87
GRAL X-SECTION CALC	CDC	1604	F63	RS PLT=	ARES2, RESONANCE INTE	89
FFUSION SLAB CYL SPHERE	CDC	1604	F63	RS PLT=	FAIM, 1-D MULTI-GP CI	120
LIDE CHAIN EQUATIONS	ORNL	1604	F63	RSBP =	NUCY, SOLUTION OF NLC	134
ISCRETE ORDINATE CALC	UNC	1604	F63	RS PLT=	DTF, 1-D MULTIGROUP D	144
I-GP SN APPROXIMATION RZ	PW	1604	F63	RS P T=	FORTRAN TDC, 2-D MULT	161
CREATE ORDINATE CODE	UNC-LASL	1604	F63	RS =	2DF, 2-D MULTI-GP DIS	172
LD FROM REACTION OR DECAY	ORNL	1604	F63	RS P =	ISOTOPES, MAXIMUM YIE	179
ECAY CHAIN ANALYSIS	ORNL	1604	F63	RS P =	ISOCRUNCH, REACTION C	180
IMPELLER DESIGN STUDY	PW	1604	F63	RS P T=	PIP, CENTRIFUGAL PUMP	187
CTION EVALUATION	PW	1604	F63	RS P =	CMPXMAT, TRANSFER FUN	188
N CONSTANTS FOR OSN TDC	PW	1604	F63	RS P =	SNC, CALCULATION OF S	189
GHT OPTIMIZATION STUDY	PW	1604	F63	RS =	WCPEXPRT, REACTOR WEI	190
CAICS-HYDRODYNAMICS SPH	PW	1604	F63	RS P =	AX-INT, COUPLED NEUTR	191
LUX SYNTHESIS PROGRAM CYL	PW	1604	F63	RS T=	2CXYL, 3-D MULTI-GP F	192
IBRARY TAPE PREPARATION	PW	1604	F63	RS =	CSP2A, SN X-SECTION L	193
BRARY TAPE PREPARATION	PW	1604	F63	RS =	CSP1, SN X-SECTION LI	194
TDC OR 2DXY FLUX INPUT	PW	1604	F63	RS =	TDP, 2-D PERTURBATION	199
OCG2 INSTRUCTION SET	PW	1604	F+CDP	RS P T=	LAG, ASSEMBLER FOR FL	186
ON, GAMMA-RAY HISTORIES	PW	1604	F+CDP	RS P T=	FMC-N/FMC-G, PC NEUTR	195
ION CALC FROM OSN OUTPUT	PW	1604	LAG1	RS P =	DTX, EFFECTIVE X-SECT	210
N APPROX SLAB CYL SPHERE	PW	1604	LAG1	RS P =	MGDSN, 1-D MULTI-GP S	211
AI 7090 F2	RS =	SAIL, 1-D 1-GP SN APPROXIMATION SLAB GEOMETRY				52
RS =	S4 CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION	AI 7090 F2				53
3 RS =	S4 CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION	CDC 1604 F6				53
APL 6600 F4	RS P T=	HIGL2, 1-D 2-GP SPACE-TIME DIFFUSION 3-GEOM	B			R274
OA 360 F4	RS PLT=	FIRE2, 1-D ACE-DIFFUSION SLAB CYLINDER SPHERE	R			9
UK-R 7090 F+FAP	RSEPLT=	GRAM, 1-D AND 2-D MULTI-GP DIFFUSION PROGRAM				103
AI 7090 F2	RS P T=	FUG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE				26
CDC 1604 F63	RS P T=	FUG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE				26
PP 7090 F2	RS P =	MIST, 1-D FEW-GP SN DOUBLE SN APPROX SLAB GEOM				59
A 7090 F2	RSB T=	FEVER, 1-D FEW-GP DIFFUSION DEPLETION PROGRAM	G			117
P 7040 F4	RS P T=	TOPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER	P			148
P 7090 F2	RS P T=	TOPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER	P			148
A 7044 F4	RS P T=	GASP2, 1-D FEW-GP DIFFUSION POWER DIST SEARCH	G			220
4 F4	RS P T=	RELOAD-FEVER, 1-D FEW-GP DIFFUSION DEPLETION	GA 704			221
A 7044 F4	RS P T=	TEMCC, 1-D FEW-GP DIFFUSION TEMP COEF CALC	G			225
360 F4	RSBP T=	THREDES, 1-D FEW-GP DIFFUSION DESIGN SYSTEM	AI			273
AI 7090 F+FAP	RS PLT=	AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE				29
CDC 1604 F63	RS PLT=	AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE				29

7090 F2	RS LT= SIZZLE,	1-D MULTIGROUP DIFFUSION DEPLETION	AI	58	
C 1604 F63	RS LT= SIZZLE,	1-D MULTIGROUP DIFFUSION DEPLETION	CD	58	
360 F4	RSPPT= SIZZLE,	1-D MULTIGROUP DIFFUSION DEPLETION	AI	56	
90 FLOCC RSEP T=	CE-HAPC-S13,	1-D MULTI-GP DOUBLE SN APPROX	BNWL 70	75	
I 7090 F+FAP RS	LT= LLCER,	1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	A	118	
AI 7090 F+FAP RS	LT= FAIM,	1-D MULTI-GP DIFFUSION SLAB CYL SPHERE		120	
CDC 1604 F63	RS PLT= FAIM,	1-D MULTI-GP DIFFUSION SLAB CYL SPHERE		120	
EC 360 F4	RS P T= FAIMOS,	1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	80	120	
K-W 7090 F2	RS P T= W-DSN,	1-D MULTI-GP SN APPROX SLAB CYL SPHERE	L	132	
UNC 1604 F63	RS PLT= DTF,	1-D MULTIGROUP DISCRETE ORDINATE CALC		144	
AI 7090 F2	RS PLT= DTF2,	1-D MULTI-GP DISCRETE ORDINATE CALC		151	
I 360 F4	RSPPLT= ANISA,	1-D MULTI-GP DISCRETE ORDINATE CALC	A	151	
LASL 7030 F4	RS P T= DTF4,	1-D MULTI-GP DISCRETE ORDINATE PROGRAM		205	
LRC 7094 F4	RS P T= DTF4,	1-D MULTI-GP DISCRETE ORDINATE PROGRAM		209	
LASL 6600 F4	RS P T= DTF4,	1-D MULTI-GP DISCRETE ORDINATE PROGRAM		209	
BEC 625 F4	RS P T= DTF4,	1-D MULTI-GP DISCRETE ORDINATE PROGRAM		205	
ANL 360 F4	RS P T= DTF4,	1-D MULTI-GP DISCRETE ORDINATE PROGRAM		205	
W 1604 LAG1	RS P = PGESN,	1-D MULTI-GP SN APPROX SLAB CYL SPHERE	P	211	
BNWL 1107 F4	RS P T= FFA,	1-D MULTI-GP DIFFUSION SLAB CYL SPHERE		241	
NL 3600 F63	RS P T= FACH1,	1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	A	262	
7030 F4	RS P T= DTF-BURN,	1-D MULTI-GP DTF4 WITH DEPLETION	LASL	269	
F4	RS8PLT= CAESAR4/LIBLST,	1-D MULTI-GP DIFFUSION + LIE	AI 360	270	
AI 7090 F2	RS = PERT,	1-D PERTURBATION FOR AIM AND FOG CODES		30	
CDC 1604 F63	RS = PERT,	1-D PERTURBATION FOR AIM AND FOG CODES		30	
BGEC 360 F4	RS P = PERT,	1-D PERTURBATION FOR AIM AND FOG CODES		30	
RS = S4 CYL CELL CODE,	1-D	1-GP S4 APPROXIMATION	AI 7090 F2	53	
RS = S4 CYL CELL CODE,	1-D	1-GP S4 APPROXIMATION	CDC 1604 F63	52	
7090 F2	RS = SAIL,	1-D	1-GP SN APPROXIMATION SLAB GEOMETRY	AI	52
90 F2	RS = SNAPKINS, SA,	1-REGION KINETICS SNAP GEOMETRY	AI 70	122	
LAC-LASL 1604 F63	RS =	2DF, 2-D MULTI-GP DISCRETE ORDINATE CODE		173	
TDP, 2-D PERTURBATION TDC CR		2DXY FLUX INPUT PW 1604 F63	RS =	195	
M CYL PW 1604 F63	RS T=	2DXYL, 3-D MULTI-GP FLUX SYNTHESIS PROCRA		192	
DN AGN 7090 FLOCC RSEP =		2DXY, 2-D MULTI-GP SN APPROXIMATION XY CE		18	
LASL 7094 FAP	RS P T= RATH,	2- OR 3-D HEAT CONDUCTION LUMPED MASS		242	
090 F2	RS P T= EQUIPOISE2,	2-D 2-GROUP DIFFUSION SLAB CYL	CRNL 7	39	
90 F2	RS P T= EQUIPOISE3A,	2-D 2-GP DIFFUSION CYLINDER SLAB	CRNL 70	87	
04 F63	RS P T= EQUIPOISE3A,	2-D 2-GP DIFFUSION CYLINDER SLAB	CCC 16	87	
= FLOW-MODEL, MULTI-CHANNEL		2-D 2-PHASE FLOW	AI 7094 F2	RS P	246
-PLANE, PLANE STRESS ANALYSIS,		2-D BODIES GA 1108 F4	RS P = SAFE		252
IZZA, PLANE STRESS ANALYSIS CF		2-D BODIES CA 7044 F4	RS P T= P		230
T= CPC, DATA PREPARATION FOR		2-D DESIGN PROGRAMS LASL 7090 F2	RS P		234
LRL 709 F2	RS = FIRN,	2-D FEW-GP S4 APPROXIMATION RZ GEOMETRY			7
L 7090 F2	RS P T= 20CRAND,	2-D FEW-GROUP DIFFUSION SLAB CYLINDER CRN			40
1604 F63	RS P T= 20CRAND,	2-D FEW-GROUP DIFFUSION SLAB CYLINDER CCC			40
GA 7090 F+FAP RSEP T=	CLB,	2-D FEW-GP DIFFUSION PURNLP RZ GEOMETRY			99
PLCCST5, PLINT-KINETICS WITH		2-D HEAT TRANSFER GA 7044 F4	RS T=		205
AGN 7090 FLOCC RSEP =	2DXY,	2-D MULTI-GP SN APPROXIMATION XY GEOM			18
O F+FAP RSEPLT=	CRAN, 1-D AND	2-D MULTI-GP DIFFUSION PROGRAM	LK-R 709		103
C F+FAP RS P T=	EXTERMINATOR,	2-D MULTI-GP DIFFUSION PROGRAM	CRNL 709		156
F4	RS P T= EXTERMINATOR2,	2-D MULTI-GP DIFFUSION PROGRAM	CRNL 360		156
04 F63	RS P T= FORTRAN TDC,	2-D MULTI-GP SN APPROXIMATION RZ PW	16		161
-LASL 1604 F63	RS = 2DF,	2-D MULTI-GP DISCRETE ORDINATE CODE	UNC		173
P RS P T=	VARI-QUIR, TIME-LEP	2-D MULTI-GP DIFFUSION	WAL 7090 F+FA		212
7044 F+FAP RSEP T=	CABLE4,	2-D MULTI-GP DIFFUSION XY RZ GEOMETRY GA			222
L 7090 F+FAP RS P T=	ASSALLT,	2-D MULTI-GP DIFFUSION DEPLETION CODE CRN			240
094 F4	RS P T= VARI-QUIP3,	2-D MULTI-GP DIFFUSION XY RZ RTH	WAL 7		264
PW 1604 F63	RS = TDP,	2-D PERTURBATION TDC CR 2DXY FLUX INPUT			199
Z	RS P T= EQUIPOISE3A, 2-D	2-GP DIFFUSION CYLINDER SLAB	CRNL 7090 F		87
63	RS P T= EQUIPOISE3A, 2-D	2-GP DIFFUSION CYLINDER SLAB	CCC 1604 F		87
6600 F4	RS P T= WICL2, 1-D	2-GP SPACE-TIME DIFFUSION 3-GEOM	BAPL		R274
F2	RS P T= WIRLAWAY, 3-D	2-GROUP DIFFUSION XYZ GEOMETRY	CRNL 7090		32

F63	RS P T=	WHIRLAWAY, 3-D	2-GROUP DIFFUSION XYZ GEOMETRY	CDC	1604	32
F2	RS P T=	EQUIPOISE3, 2-D	2-GROUP DIFFUSION SLAB CYL	CRNL	7090	39
FLOW-MODEL, MULTI-CHANNEL	2-D	2-PHASE FLOW	AI	7094 F2	RS P =	246
-RAFF, RESONANCE INTEGRAL CALC	2-REG CELL	ANL	3600 F63	RSBP T=	RIFF	213
IGNS AI	7094 F2	RS P T=	2PLUS, NON-SPHERICAL OPTICAL MODEL X-SECT			254
IONS ANL	3600 F63	RSBP T=	2PLUS, NON-SPHERICAL OPTICAL MODEL X-SECT			254
INCR CRNL	7090 F2	RS P T=	20GRAND, 2-D FEW-GROUP DIFFUSION SLAB CYL			40
INCR CDC	1604 F63	RS P T=	20GRAND, 2-D FEW-GROUP DIFFUSION SLAB CYL			40
TEGRAL X-SECTION CALC	GESJ	2000 F2	RS P =	RAPTURE, RESONANCE IN		176
ANCE X-SECTION CALC	GESJ	2000 F2	RS P =	DCPIE, RESOLVED RESON		177
RAGED DOPPLER EFFECTS	GESJ	2000 F2	RS P =	SPARTA, SPATIALLY-AVE		178
CURSION CALCULATIONS	GESJ	2000 F4	RS P T=	FCRE, FAST REACTOR EX		174
4.5-14,500PSIA 32-472CEGF	BAPL	2000 F4	RS	=	WATER, STEAM TABLES 1	R267
LING TEMPERATURE STUDY	BAPL	2000 F4	RS P =	FIGRO, LSBR FUEL SWEL		R272
ON SLAB CYLINDER SPHERE	RGA	360 F4	RS PLT=	FIRE2, 1-D AGE-DIFFUSI		9
FOR AIP AND FOG CODES	BCEC	360 F4	RS P =	FERT, 1-D PERTURBATION		30
RATE FROM A CLOUD	SRL	360 F4	RS P =	CLOUD, GAMMA-RAY DISE		47
RGN SPECTRUM X-SECTIONS	BCEC	360 F4	RS PLT=	TEPPEST2, THERMAL NEUT		50
DIFFUSION DEPLETION	AI	360 F4	RSBP T=	SIZZLE, 1-D MULTIGROUP		58
DIFFUSION SLAB CYL SPHERE	BCEC	360 F4	RS P T=	FAIMOS, 1-D MULTI-GP D		120
ENT KINETICS W/FEEDBACK	RCA	360 F4	RS P =	AIREK3, SPACE-INDEPEND		121
ELASTIC SCAT RESONANCES	AI	360 F4	RS PLT=	AILMGE, X-SECTION CALC		147
SCRETE COORDINATE CALC	AI	360 F4	RSBP LT=	ANISA, 1-D MULTI-GP CI		151
TI-GP DIFFUSION PROGRAM	CRNL	360 F4	RS P T=	EXTERMINATOR2, 2-D MUL		156
NT KINETICS W/FEEDBACK	AI	360 F4	RSBP T=	AIRDS, SPACE-INDEPEND		163
CRETE COORDINATE PROGRAM	ANL	360 F4	RS P T=	CTF4, 1-D MULTI-GP DIS		209
LI-GP DIFFUSION + LIB	AI	360 F4	RSBP LT=	CAESAR4/LIBEST, 1-D MU		270
LIBRARY UTILITY ROUTINE	AI	360 F4	RSB LT=	CLIP, FORM OR THREDES		271
FFUSION DESIGN SYSTEM	AI	360 F4	RSBP T=	THREDES, 1-D FEW-GP CI		272
INENT ANALYSIS SYSTEM BNL-SRL		360 F4	RS PLT=	HAMMER, CRITICAL EXPER		277
LOWDOWN ANALYSIS LEFT	UG	360 F4	RS P =	WATER-HAMMER, LIQUID B		278
BLOWDOWN ANALYSIS LEFT	KE	3600 F2	RSBP =	WATER-HAMMER, LIQUID B		278
CS-HYDRODYNAMICS SPHERE	CDC	3600 F63	RSBP =	AX1, COUPLED NEUTRONI		102
NSFER FUNCTION SYNTHESIS	ANL	3600 F63	RSBP T=	TRAFICOPERATION, TRA		135
ERATURE CALC CYLINDER	ANL	3600 F63	RSBP T=	ARGUS, TRANSIENT TEP		152
AND POWER DISTRIBUTION	CDC	3600 F63	RSBP T=	FLARE, 3-D REACTIVITY		167
NT INVERSE KINETICS CALC	ANL	3600 F63	RSBP =	R102, SPACE-INDEPEND		168
LELS X-SECTION CALC	ANL	3600 F63	RSBP =	NEARREX, COMPOUND NUC		171
REQUIREMENT STUDY	ANL	3600 F63	RS P T=	R153, PARAMETRIC SITE		172
RARY UTILITY ROUTINE	ANL	3600 F63	RSBP T=	XLBIT, X-SECTION LIB		181
SPECTRUM X-SECTION CALC	ANL	3600 F63	RS P T=	THERMOS(ANL), THERMAL		184
INTEGRAL CALC 2-REG CELL	ANL	3600 F63	RSBP T=	RIFF-RAFF, RESONANCE		212
INTEGRAL CALC HOMOGENEOUS	ANL	3600 F63	RSBP =	MISH-MASH, RESONANCE		214
UNTING DATA REDUCTION	ANL	3600 F63	RSBP =	CCINC, COINCIDENCE CO		248
OPTICAL MODEL X-SECTIONS	ANL	3600 F63	RSBP T=	2PLLS, NON-SPHERICAL		254
NT KINETICS KEX OPTICS	ANL	3600 F63	RSBP =	R101, SPACE-INDEPEND		255
DIFFUSION SLAB CYL SPHERE	ANL	3600 F63	RS P T=	MACP1, 1-D MULTI-GP D		262
7090 F2	RS P T=	WHIRLAWAY, 3-D	2-GROUP DIFFUSION XYZ GEOMETRY	CRNL		32
1604 F63	RS P T=	WHIRLAWAY, 3-D	2-GROUP DIFFUSION XYZ GEOMETRY	CDC		32
00 F+ASC RS	T=	POC7, 1,2 CR	3-D FEW-GP DIFFUSION DEPLETION	BAPL	66	R275
094 FAP	RS P T=	RATH, 2- CR	3-D HEAT CONDUCTION LUMPED MASS	LA5L	7	242
h	1604 F63	RS	T=	2DXYL, 3-D MULTI-GP FLUX SYNTHESIS PROGRAM CYL P		192
ESJ	635 F4	RS P T=	FLARE, 3-D REACTIVITY AND POWER DISTRIBUTION	G		167
CC	3600 F63	RSBP T=	FLARE, 3-D REACTIVITY AND POWER DISTRIBUTION	C		167
1-D 2-GP SPACE-TIME DIFFUSION	3-GEOM	BAPL	6600 F4	RS P T=	WIGL2,	R274
LC	AI	7090 F+AP RS	T=	4RESTRAINT PIPE STRESS, MAXIMUM MOMENT CA		109
CRETE COORDINATE PROGRAM	BEC	625 F4	RS P T=	CTF4, 1-D MULTI-GP DIS		209
SECTION CALCULATION	GEC	625 F4	RS P =	AVOID, ANNULAR VOID X-		276
AND POWER DISTRIBUTION	GESJ	635 F4	RS P T=	FLARE, 3-D REACTIVITY		167
CURSION CALCULATIONS	GESJ	635 F4	RS P T=	FCRE2, FAST REACTOR EX		174
ERMAL-HYDRAULIC ANALYSIS	GESJ	625 F4	RS P T=	MAATA, STEADY-STATE TH		256

CE EPITHERMAL X-SECTIONS	GESJ	635 F4	RS P T=	REAX, RESOLVED RESONAN	257
ED NEUTRON SOURCE DATA	GESJ	635 F4	RS P T=	EXPAN, ANALYSIS OF PULS	258
SCRETE ORDINATE PROGRAM	LASL	6600 F4	RS P T=	DTF4, 1-D MULTI-GP OI	209
IS CYL FUEL ELEMENT	BAPL	6600 F4	RS T=	CYGR02, STRESS ANALYS	R266
-TIME DIFFUSION 3-GEOM	BAPL	6600 F4	RS P T=	WIGL2, 1-D 2-GP SPACE	R274
GP DIFFUSION DEPLETION	BAPL	6600 F+ASC	RS T=	PDQT, 1,2 OR 3-D FEW-	R275
SCRETE ORDINATE PROGRAM	LASL	7030 F4	RS P T=	DTF4, 1-D MULTI-GP OI	209
P DTF4 WITH DEPLETION	LASL	7030 F4	RS P T=	DTF-BURN, 1-D MULTI-G	269
ANALYSIS PARTIAL REFUEL	GA	7044 F4	RS P T=	GARGOYLE, FUEL CYCLE	260
CS WITH 2-D HEAT TRANSFER	GA	7044 F4	RS T=	BLOOST5, POINT-KINETI	205
TS FROM X-SECTION TAPES	GA	7044 F4	RSBP T=	CROSSPLOT, SC4020 PLO	207
ON B-W RESONANCE DATA	GA	7044 F4	RS P =	FASDOP, X-SECTIONS FR	216
EF CALC FOR ANGULAR DIST	GA	7044 F4	RS P =	LEGCOEF3, LEGENDRE CO	217
L X-SECTION AVERAGING	GA	7044 F4	RS P =	GAVER, ENERGY INTERVA	218
FUSION POWER DIST SEARCH	GA	7044 F4	RS P T=	GASP2, 1-D FEW-GP OIF	220
-GP DIFFUSION DEPLETION	GA	7044 F4	RS P T=	RELOAD-FEVER, 1-D FEW	221
LE ANALYSIS W/REFUELING	GA	7044 F4	RS P T=	REVISED-GAD, FUEL CYC	222
STS PERFORMANCE STUDY	GA	7044 F4	RS P =	KAMPUM, FUEL CYCLE CO	224
FUSION TEMP COEF CALC	GA	7044 F4	RS P T=	TEMCO, 1-D FEW-GP OIF	225
OR DESIGN CRITERIA COSTS	GA	7044 F4	RS P T=	STMGEN, STEAM GENERAT	227
ENT PRESSURE POST RUPTURE	GA	7044 F4	RS T=	PRECON, HTGR CONTAINM	228
TRESS ANALYSIS STUDY	GA	7044 F4	RS P T=	ELBOW, FUEL ELEMENT S	229
NALYSIS OF 2-D BODIES	GA	7044 F4	RS P T=	PIZZA, PLANE STRESS A	230
DUCT ACTIVITY DIST STUDY	GA	7044 F4	RS P =	RAD2, HTGR FISSION PR	231
CORE THERMAL DESIGN STUDY	GA	7044 F4	RS P =	GAZELLES, GAS-COOLED	232
ION FUEL TEMPERATURE CODE	GA	7044 F4	RS =	CGRE, CORE CONFIGURAT	233
AW X-SECTION CALCULATION	GA	7044 F4	RS =	FLANGE1, SCATTERING L	247
YSIS AXISYMMETRIC LOAD	GA	7044 F4	RS P T=	SAFE-PCRS, STRESS ANA	250
NALYSIS AXISYMMETRIC LOAD	GA	7044 F4	RS P T=	SAFE-AXISYM, STRESS A	251
M SCISRS X-SECTION TAPE	GA	7044 F+MAP	RSBP =	UNPACK, RETRIEVAL FRO	206
LAP AND LATTICE EFFECTS	GA	7044 F+MAP	RS P T=	GAROL, RESONANCE OVER	219
DIFFUSION XY RZ GEOMETRY	GA	7044 F+MAP	RSBP T=	GAMBLE4, 2-D MULTI-GP	222
FORMANCE AND PRICE STUDY	GA	7044 F+MAP	RS P T=	OPUS, POWER PLANT PER	226
APPROXIMATION CYLINDER	PP	7040 F4	RS P T=	TOPIC, 1-D FEW-GP SN	148
MULTI-LEVEL CONVOLUTION	PP	7040 F4	RS P =	COMBCC, COMBINED B-W	203
FETY ANALYSIS PROGRAM	PP	7040 MAP	RSBP T=	RSAC, RADIOLOGICAL SA	265
PROXIMATION RZ GEOMETRY	LRL	709 F2	RS =	FIRN, 2-D FEW-GP S4 AP	7
B-W RESONANCE PARAMETERS	WAL	7094 F2	RS P =	EXT, X-SECTIONS FROM	238
M SCISRS X-SECTION TAPES	WAL	7094 F2	RS T=	CPS, SC4020 PLOTS FRO	239
IC CYCLE ANALYSIS	AI	7094 F2	RS PLT=	CYCLOPS1, THERMODYNAM	244
NNEL 2-D 2-PHASE FLOW	AI	7094 F2	RS P =	FLOW-MODEL, MULTI-CHA	246
OPTICAL MODEL X-SECTIONS	AI	7094 F2	RS P T=	ZPLUS, NON-SPHERICAL	254
ED NEUTRON-HYDRODYNAMICS	APDA	7094 F2	RS P =	WEAK EXPLOSION, COUPL	145
RE TEMPERATURE HISTORY	KE	7094 F2	RSBP T=	PTH1, BLOWDOWN PRESSU	155
MOLTEN FUEL TUBE BUNDLES	LASL	7094 F2	RS P =	AXFLU, HEAT TRANSFER	182
SOLID FUEL TUBE BUNDLES	LASL	7094 F2	RS P =	AXTHRM, HEAT TRANSFER	183
PTIMIZATION DOSE CALC	AI	7094 F2	RS P =	SHOE, SHIELD WEIGHT O	197
STEADY-STATE HEAT TRANSFER	AI	7094 F2	RS P T=	HEATING2, TRANSIENT S	198
NT FLOW AND HEAT TRANSFER	AI	7094 F2	RS P T=	TRANS-FUGUEL, TRANSIE	268
NT INVERSE KINETICS CALC	WAL	7094 F4	RS =	R102, SPACE-INDEPEND	162
NT KINETICS KEX OPTIONS	WAL	7094 F4	RS P =	R101, SPACE-INDEPEND	255
ENERAL CURVE FITTING	LASL	7094 F4	RS =	LASL LEAST SQUARES, G	62
SCRETE ORDINATE PROGRAM	LRC	7094 F4	RS P T=	DTF4, 1-D MULTI-GP DI	205
-SECTIONS FOR GAMMA-RAYS	GEC	7094 F4	RS P =	GAMMA-P, PRODUCTION X	235
-GP DIFFUSION XY RZ RTH	WAL	7094 F4	RS P T=	VARI-CUIR3, 2-D MULTI	264
LOWING-DOWN DENSITY CALC	AI	7094 F+MAP	RS PLT=	TYCHE3, MONTE CARLO S	149
ARY UTILITY PROGRAM	AI	7094 F+MAP	RS LT=	MEMUS, X-SECTION LIBR	159
G X-SECTIONS PARAMETERS	AI	7094 F+MAP	RS PLT=	GRAVE, GROUP-AVERAGIN	162
ENT KINETICS W/FEEDBACK	AI	7094 F+MAP	RS P T=	AIROS, SPACE-INDEPEND	163
ITE REQUIREMENT STUDY	AI	7094 F+MAP	RS P T=	AISITE2, PARAMETRIC S	172
D, EXTERNAL+INTERNAL DOSE	AI	7094 F+MAP	RS PLT=	CURIE/DOSE/THUNDERHEA	196

BLOWDOWN ANALYSIS LOFT	KE	7094	F+FAP	RSBP	T=	SATURATED BLOWDOWN1,	200
AND X-SECTION CALCULATION	GEV	7094	F+FAP	RS	P T=	EPITHERMOS, SPECTRUM	201
GRAL X-SECTION CALC	AI	7094	F+FAP	RS	PLT=	TRIX1, RESONANCE INTE	208
ALC FOR ANGULAR DIST DATA	AI	7094	F+FAP	RS	P =	CHAD, LEGENDRE COEF C	215
WITH BURNUP CYL LATTICE	WAPD	7094	F+FAP	RS	PLT=	LASER, SPECTRUM CALC	245
CONDUCTION LUMPED MASS	LASL	7094	FAP	RS	P T=	RATH, 2- OR 3-D HEAT	242
FOR 2-D DESIGN PROGRAMS	LASL	7090	F2	RS	P T=	DPC, DATA PREPARATION	234
MULTI-PIN FUEL ELEMENT	AGN	7090	F2	RS	P =	BCUNCE, FLUX DIST IN	237
LYI-GP TRANSFER MATRICES	AGN	7090	F2	RS	P T=	AGN-SIGMA, CALC OF MU	243
SIGN SLAB CYLINDER SPHERE	AI	7090	F2	RS	P T=	FCG, 1-D FEW-GP DIFFU	26
N FOR AIM AND FCG CODES	AI	7090	F2	RS	=	PERT, 1-D PERTURBATIO	30
P DIFFUSION XYZ GEOMETRY	GRNL	7090	F2	RS	P T=	WHIRLAWAY, 3-D 2-GROU	32
ECTRUM X-SECTION CALC	CA	7090	F2	RS	PLT=	GAM1, FAST NEUTRON SP	33
UP DIFFUSION SLAB CYL	CRNL	7090	F2	RS	P T=	EQUIPOISE3, 2-D 2-GRO	39
P DIFFUSION SLAB CYLINDER	CRNL	7090	F2	RS	P T=	20GRAND, 2-D FEW-GROU	40
ENUATION SLAB GEOMETRY	AI	7090	F2	RS	P =	GRACE1, GAMMA-RAY ATT	45
ENUATION CYL SPHERE GEOM	AI	7090	F2	RS	P =	GRACE2, GAMMA-RAY ATT	46
RATE FROM A CLOUD	AI	7090	F2	RS	P =	CLOUD, GAMMA-RAY DOSE	47
EMPERATURE VOID FRACTION	AI	7090	F2	RS	=	FLGUE, STEADY-STATE T	48
ECTRUM X-SECTION CALC	AI	7090	F2	RS	PLT=	FORM, FAST NEUTRON SP	51
ROXIMATION SLAB GEOMETRY	AI	7090	F2	RS	=	SAIL, 1-D 1-GP SN APP	52
1-GP S4 APPROXIMATION	AI	7090	F2	RS	=	S4 CYL CELL CODE, 1-D	53
CYCLE COST ANALYSIS	AI	7090	F2	RS	P =	AIMFIRE, URANIUM FUEL	55
CATTERING KERNEL CALC	GA	7090	F2	RS	T=	SLMPIT, CRYSTALLINE S	56
P DIFFUSION DEPLETION	AI	7090	F2	RS	LT=	SIZZLE, 1-D MULTIGROU	58
DOUBLE SN APPROX SLAB GEOM	PP	7090	F2	RS	P =	MIST, 1-D FEW-GP SN D	59
DIFFUSION CYLINDER SLAB	CRNL	7090	F2	RS	P T=	EQUIPOISE3A, 2-D 2-GP	87
GRAL X-SECTION CALC	AI	7090	F2	RS	PLT=	ARES2, RESONANCE INTE	89
GM SNAP SHIELD LEAKAGE	AI	7090	F2	RS	=	FARSELA, DOSE RATE FR	91
AND TEMPEST COMBINATION	AI	7090	F2	RS	P =	BAM, S4 CYL CELL CODE	108
RADIATOR FINS SNAP GEOM	AI	7090	F2	RS	=	SCARF2, SCATTER FROM	110
RING SNAP GEOMETRY	AI	7090	F2	RS	=	SCAR1, SCATTER FROM A	111
ANT DESIGN OPTIMIZATION	AI	7090	F2	RS	=	CROCK, SPACE POWER PL	112
ANT DESIGN OPTIMIZATION	AI	7090	F2	RS	=	SHOCK, SPACE POWER PL	114
FUSION DEPLETION PROGRAM	CA	7090	F2	RSB	T=	FEVER, 1-D FEW-GP CIF	117
DENT KINETICS W/FEEDBACK	AI	7090	F2	RS	=	AIREK3, SPACE-INDEPEN	121
KINETICS SNAP GEOMETRY	AI	7090	F2	RS	=	SNAPKINS, SA, 1-REGION	122
PENETRATION CALCULATION	DAC	7090	F2	RSBP	=	LIPRECAM1, MC NEUTRON	123
NICS-HYDRODYNAMICS SPHERE	LRLI	7090	F2	RS	P =	CONEC, COUPLED NEUTRO	129
N APPROX SLAB CYL SPHERE	UK-W	7090	F2	RS	P T=	W-DSN, 1-D MULTI-GP S	132
E EDIT REACTION RATES	UK-W	7090	F2	RS	=	WED, W-DSN OUTPUT TAP	133
LIDE CHAIN EQUATIONS	CRNL	7090	F2	RSBP	=	NLCY, SOLUTION OF NUC	134
METERS HETEROGENEOUS CALC	FMA	7090	F2	RSBP	=	HERESYL, LATTICE PARA	136
CULATION SNAP GEOMETRY	AI	7090	F2	RS	P =	RATRAP, DOSE RATE CAL	141
ALCULATION SNAP GEOMETRY	AI	7090	F2	RS	=	MCRTIMER, DOSE RATE C	142
LTIGROUP SLAB GEOMETRY	BNWL	7090	F2	RSBP	LT=	MAC, SHIELD DESIGN MU	142
DSTS PERFORMANCE DATA	KE	7090	F2	RSBP	=	NPRFCCP, FUEL CYCLE C	146
APPROXIMATION CYLINDER	PP	7090	F2	RS	P T=	3CPIC, 1-D FEW-GP SN	148
SPACE CHORD DIST FUNCT	AEG	7090	F2	RS	=	DANCOFF JR, MODERATOR	150
SCRETE COORDINATE CALC	AI	7090	F2	RS	PLT=	CIF2, 1-D MULTI-GP CI	151
RONICS-HYDRODYNAMICS CODE	AGN	7090	F2	RSB	=	HATCHET, COUPLED NEUT	153
OW EXPERIMENT ANALYSIS	AGN	7090	F2	RS	P =	CROC90, PL-1 FLUTE FL	154
ECAY CHAIN ANALYSIS	CRNL	7090	F2	RS	P =	ISOCRUNCH, REACTION D	180
M MULTI-GP CONSTANT CALC	AGN	7090	F2	RSBP	LT=	AGN-GAM, FAST SPECTRU	204
RIMENT ANALYSIS SYSTEM	BNL-SRL	7090	F2	RS	PLT=	HAMMER, CRITICAL EXPE	277
FFUSION SLAB CYL SPHERE	AI	7090	F+FAP	RS	PLT=	AIM6, 1-D MULTI-GP CI	29
RESONANCE INTEGRAL CALC	GA	7090	F+FAP	RSB	T=	ZLT, RESOLVED REGION	41
N RESONANCE INTEGRAL CALC	GA	7090	F+FAP	RSB	T=	TLZ, UNRESOLVED REGIO	42
TRON SPECTRUM X-SECTIONS	AI	7090	F+FAP	RS	PLT=	TEMPEST2, THERMAL NEU	50
SIGN BURNUP RZ GEOMETRY	GA	7090	F+FAP	RSBP	T=	DCR, 2-D FEW-GP DIFFU	95
TI-GP DIFFUSION PROGRAM	UK-R	7090	F+FAP	RSBP	LT=	CRAM, 1-D AND 2-D MUL	103

S, MAXIMUM MOMENT CALC	AI	7090	F+FAP	RS	T=	4RESTRAINT PIPE STRES	106	
DIFFUSION SLAB CYL SPHERE	AI	7090	F+FAP	RS	LT=	ULCER, 1-D MULTI-GP D	118	
IMP SPECTRUM X-SECTIONS	AI	7090	F+FAP	RS	LT=	QUICKIE, INFINITE MED	119	
DIFFUSION SLAB CYL SPHERE	AI	7090	F+FAP	RS	LT=	FAIM, 1-D MULTI-GP CI	120	
C ELASTIC SCAT RESONANCES	AI	7090	F+FAP	RS	PLT=	AILMOE, X-SECTION CAL	147	
TI-GP DIFFUSION PROGRAM	GRNL	7090	F+FAP	RS	P T=	EXTERMINATOR, 2-D MUL	156	
P TRANSFER COEFFICIENTS	LRLL	7090	F+FAP	RS	P T=	SOPHIST1/2/5, MULTI-G	160	
START CALC 0 TO 10 MEV	BNWL	7090	F+FAP	RS	PLT=	GAMTEC2, MULTI-GP CGN	185	
-D MULTI-GP DIFFUSION	KAL	7090	F+FAP	RS	P T=	VARI-QUIR, TIME-DEP 2	212	
CE ROUTINES ENDF TAPES	BNL	7090	F+FAP	RS	P T=	DFSR, DATA FILE SERVI	236	
DIFFUSION DEPLETION CODE	GRNL	7090	F+FAP	RS	P T=	ASSAULT, 2-D MULTI-GP	240	
ULATION WITH DEPLETION	WAPD	7090	F+FAP	RSBPLT=		LEOPARD, SPECTRA CALC	279	
APPROXIMATION XY GEOM	AGN	7090	FLOCC	RSBP	=	2CXY, 2-D MULTI-GP SN	18	
I-GP DOUBLE SN APPROX	BNWL	7090	FLOCC	RSBP	T=	GE-MAPD-S13, 1-D MULT	75	
GF MULTI-GP X-SECTIONS	LASL	7090	FLOCC	RS	P	=	ZCT, GROUP-COLLAPSING	112
RCN PENETRATION STUDY	LASL	7090	FLOCC	RS	P	=	MCS, MONTE CARLO NEUT	202
IENCY POINT SOURCE	UM	7090	MAC	RSB	=	BLRP1, DETECTOR EFFIC	164	
IENCY DISK SOURCE	UM	7090	MAC	RSB	=	BLRP2, DETECTOR EFFIC	165	
IENCY POINT SOURCE	UM	7090	MAC	RSB	=	BLRP3, DETECTOR EFFIC	166	
GFRACTION SOLID CRYSTAL	UM	7090	MAC	RSB	=	BLRP4, GAMMA-RAY PHOT	165	
GFRACTION WELL CRYSTAL	UM	7090	MAC	RSB	=	BLRP5, GAMMA-RAY PHOT	170	
RS T= GADGSE/DOSET, RTGR						ACCIDENT ANALYSIS DCSE CALC GA	1108 F4	
= RAD2, RTGR FISSION PRODUCT						ACTIVITY DIST STUDY GA	7044 F4	
RATCHER SPACE CHORD DIST FLNCT	AEG	7090	F2	RS	=	DANCCFF JR, CODE	150	
360 F4 RS PLT= FIRE2, 1-D						AGE-DIFFUSION SLAB CYLINDER SPHERE	RCA	
GP SN APPROXIMATION XY GEOM	AGN	7090	FLOCC	RSBP	=	2CXY, 2-D MULTI-	18	
NEUTRONICS-HYDRODYNAMICS CODE	AGN	7090	F2	RSB	=	FATC+ET, COUPLED	153	
1D FLOW EXPERIMENT ANALYSIS	AGN	7090	F2	RS	F	=	CRCC90, PL-1 FLU	154
ECTRUM MULTI-GP CONSTANT CALC	AGN	7090	F2	RSBFLT=		AGN-GAM, FAST SP	204	
T IN MULTI-PIN FUEL ELEMENT	AGN	7090	F2	RS	P	=	BOLNCE, FLUX DIS	237
OF MULTI-GP TRANSFER MATRICES	AGN	7090	F2	RS	F T=	AGN-SIGMA, CALC	242	
CALC AGN 7090 F2 RSBPLT=						AGN-GAM, FAST SPECTRUM MULTI-GP CONSTANT	204	
ICES AGN 7090 F2 RS P T=						AGN-SIGMA, CALC OF MULTI-GP TRANSFER MATR	242	
JGROUP DIFFUSION DEPLETION	AI	360	F4	RSBF	T=	SIZZLE, 1-D MULT	58	
N CALC ELASTIC SCAT RESONANCES	AI	360	F4	RS	FLT=	AILMOE, 7-SECTION	147	
-GP DISCRETE ORIGINATE CALC	AI	360	F4	RSBFLT=		ANISH, 1-D MULTI	151	
DEPENDENT KINETICS W/FEEDBACK	AI	360	F4	RSBP	T=	AIRCOS, SPACE-IND	163	
1-D MULTI-GP DIFFUSION + LIB	AI	360	F4	RSBFLT=		CAESAR4/LIBLST,	270	
REDES LIBRARY UTILITY ROUTINE	AI	360	F4	RSB	LT=	CLIP, FORM OR TH	271	
-GP DIFFUSION DESIGN SYSTEM	AI	360	F4	RSBP	T=	THREDES, 1-D FEW	272	
DIFFUSION SLAB CYLINDER SPHERE	AI	7090	F2	RS	F T=	FCC, 1-D FEW-GP	28	
GP DIFFUSION SLAB CYL SPHERE	AI	7090	F+FAP	RS	FLT=	AIM6, 1-D MULTI-	29	
RATION FOR AIM AND FCG CODES	AI	7090	F2	RS	=	PERT, 1-D PERTUR	30	
Y ATTENUATION SLAB GEOMETRY	AI	7090	F2	RS	P	=	GRACE1, GAMMA-RA	45
Y ATTENUATION CYL SPHERE GEOM	AI	7090	F2	RS	P	=	GRACE2, GAMMA-RA	46
DCSE RATE FROM A CLCUE	AI	7090	F2	RS	F	=	CLCUE, GAMMA-RAY	47
ATE TEMPERATURE VOID FRACTION	AI	7090	F2	RS	=	FUGUE, STEADY-ST	48	
L NEUTRON SPECTRUM X-SECTIONS	AI	7090	F+FAP	RS	FLT=	TEMPEST2, THERMA	50	
EN SPECTRUM X-SECTION CALC	AI	7090	F2	RS	FLT=	FORM, FAST NEUTR	51	
N APPROXIMATION SLAB GEOMETRY	AI	7090	F2	RS	=	SAIL, 1-D 1-GP S	52	
, 1-D 1-GP S4 APPROXIMATION	AI	7090	F2	RS	=	S4 CYL CELL CODE	52	
FUEL CYCLE COST ANALYSIS	AI	7090	F2	RS	F	=	AIMFIRE, URANIUM	55
JGROUP DIFFUSION DEPLETION	AI	7090	F2	RS	LT=	SIZZLE, 1-D MULT	58	
INTEGRAL X-SECTION CALC	AI	7090	F2	RS	FLT=	ARES2, RESONANCE	89	
TE FROM SNAP SHIELD LEAKAGE	AI	7090	F2	RS	=	FARSEL4, DCSE RA	91	
CODE AND TEMPEST COMBINATION	AI	7090	F2	RS	F	=	GAM, S4 CYL CELL	108
STRESS, MAXIMUM MOMENT CALC	AI	7090	F+FAP	RS	T=	4RESTRAINT PIPE	106	
FROM RADIATOR FINS SNAP GEOM	AI	7090	F2	RS	=	SCARF2, SCATTER	110	
RCM A RING SNAP GEOMETRY	AI	7090	F2	RS	=	SCAR1, SCATTER F	111	
ER PLANT DESIGN OPTIMIZATION	AI	7090	F2	RS	=	CRCK, SPACE POW	112	
ER PLANT DESIGN OPTIMIZATION	AI	7090	F2	RS	=	SPECK, SPACE POW	114	

-GP DIFFUSION SLAB CYL SPHERE	AI	7090 F+FAP RS	LT=	ULCER, 1-D MULTI	116
E MEDIUM SPECTRUM X-SECTIONS	AI	7090 F+FAP RS	LT=	QUICKIE, INFINIT	115
GP DIFFUSION SLAB CYL SPHERE	AI	7090 F+FAP RS	LT=	FAIM, 1-D MULTI-	120
DEPENDENT KINETICS W/FEEDBACK	AI	7090 F2 RS	=	AIREK3, SPACE-IN	121
EGION KINETICS SNAP GEOMETRY	AI	7090 F2 RS	=	SNAPKINS, 5A, 1-R	122
E CALCULATION SNAP GEOMETRY	AI	7090 F2 RS	P =	RATRAP, DOSE RAT	141
ATE CALCULATION SNAP GEOMETRY	AI	7090 F2 RS	=	MORTIMER, DOSE R	142
N CALC ELASTIC SCAT RESONANCES	AI	7090 F+FAP RS	PLT=	AILMOE, X-SECTIO	147
RLC SLOWING-DOWN DENSITY CALC	AI	7094 F+FAP RS	PLT=	TYCHE3, PONTE CA	149
GP DISCRETE COORDINATE CALC	AI	7090 F2 RS	PLT=	DTF2, 1-D MULTI-	151
LIBRARY UTILITY PROGRAM	AI	7094 F+FAP RS	LT=	MCMUS, X-SECTION	159
RAGING X-SECTIONS PARAMETERS	AI	7094 F+FAP RS	PLT=	GRAVE, GROUP-AVE	162
EPENDENT KINETICS W/FEEDBACK	AI	7094 F+MAP RS	P T=	AIROS, SPACE-IND	163
RIC SITE REQUIREMENT STUDY	AI	7094 F+FAP RS	P T=	AISITE2, PARAMET	172
ERHEAD, EXTERNAL+INTERNAL DOSE	AI	7094 F+FAP RS	PLT=	CURIE/DOSE/THUND	196
GHT OPTIMIZATION DOSE CALC	AI	7094 F2 RS	P =	SHOE, SHIELD WEI	197
ENT STEADY-STATE HEAT TRANSFER	AI	7094 F2 RS	P T=	HEATING2, TRANSI	198
INTEGRAL X-SECTION CALC	AI	7094 F+MAP RS	PLT=	TRIX1, RESONANCE	206
DEF CALC FOR ANGULAR DIST DATA	AI	7094 F+MAP RS	P =	CHAD, LEGENDRE C	215
DYNAMIC CYCLE ANALYSIS	AI	7094 F2 RS	PLT=	CYCLOPS1, THERMO	244
I-CHANNEL 2-D 2-PHASE FLOW	AI	7094 F2 RS	F =	FLOW-MODEL, MULT	246
ICAL OPTICAL MODEL X-SECTIONS	AI	7094 F2 RS	P T=	2PLUS, MCA-SPHER	254
ANSIENT FLOW AND HEAT TRANSFER	AI	7094 F2 RS	F T=	TRANS-FUGUE1, TR	266
ANCES AI 7090 F+FAP RS PLT=				AILMOE, X-SECTION CALC ELASTIC SCAT RESON	147
ANCES AI 360 F4 RS PLT=				AILMOE, X-SECTION CALC ELASTIC SCAT RESON	147
= PERT, 1-D PERTURBATION FOR	AIM	AND FOG CODES	AI 7090 F2 RS		30
= PERT, 1-D PERTURBATION FOR	AIM	AND FOG CODES	CCC 1604 F63 RS		30
= PERT, 1-D PERTURBATION FOR	AIM	AND FOG CODES	BOEC 360 F4 RS P		30
ERE AI 7090 F+FAP RS PLT=				AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPH	29
ERE CDC 1604 F63 RS PLT=				AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPH	29
AI 7090 F2 RS P =				AIMFIRE, URANIUM FUEL CYCLE COST ANALYSIS	55
BACK AI 7090 F2 RS =				AIREK3, SPACE-INDEPENDENT KINETICS W/FEED	121
BACK ROA 360 F4 RS P =				AIREK3, SPACE-INDEPENDENT KINETICS W/FEED	121
ACK AI 7094 F+MAP RS P T=				AIRCS, SPACE-INDEPENDENT KINETICS W/FEEDB	162
ACK AI 360 F4 RSBP T=				AIROS, SPACE-INDEPENDENT KINETICS W/FEEDB	162
Y AI 7094 F+FAP RS P T=				AISITE2, PARAMETRIC SITE REQUIREMENT STUO	172
CHAD, LEGENDRE COEF CALC FOR	ANGULAR DIST DATA	AI	7094 F+MAP RS F =		215
GCDEF3, LEGENDRE COEF CALC FOR	ANGULAR DIST GA	7044 F4	RS F =	LE	217
C AI 360 F4 RSBPLT=				ANISN, 1-D MULTI-GP DISCRETE COORDINATE CAL	151
GP DISCRETE COORDINATE PROGRAM	ANL	360 F4	RS F T=	DTF4, 1-D MULTI-	209
, TRANSFER FUNCTION SYNTHESIS	ANL	3600 F63	RSBP T=	TRAFFICORPORATION	135
TEMPERATURE CALC CYLINDER	ANL	3600 F63	RSBP T=	ARGUS, TRANSIENT	152
PENDENT INVERSE KINETICS CALC	ANL	3600 F63	RSBP =	RIC2, SPACE-INDE	166
D NUCLEUS X-SECTION CALC	ANL	3600 F63	RSBP =	NEARREX, COMPOUN	171
SITE REQUIREMENT STLOY	ANL	3600 F63	RS F T=	R193, PARAMETRIC	172
N LIBRARY UTILITY ROUTINE	ANL	3600 F63	RSBP T=	XLIBIT, X-SECTIO	181
ERMAL SPECTRUM X-SECTION CALC	ANL	3600 F63	RS P T=	THERMOSIANL}, TH	184
ANCE INTEGRAL CALC 2-REG CELL	ANL	3600 F63	RSBP T=	KIFF-RAFF, RESON	213
ANCE INTEGRAL CALC HOMOGENEOUS	ANL	3600 F63	RSBP =	MISH-MASH, RESON	214
CE COUNTING DATA REDUCTION	ANL	3600 F63	RSBP =	CCINC, CCINCIDEN	248
ICAL OPTICAL MODEL X-SECTIONS	ANL	3600 F63	RSBP T=	2PLUS, MCA-SPHER	254
PENDENT KINETICS KEX OPTIONS	ANL	3600 F63	RSBP =	RIC1, SPACE-INDE	255
-GP DIFFUSION SLAB CYL SPHERE	ANL	3600 F63	RS F T=	MAC+1, 1-D MULTI	262
EC 625 F4 RS P =	AVGID,			ANNUAL VOID X-SECTION CALCULATION	276
COUPLED NEUTRON-HYDRODYNAMICS	APDA 7094 F2	RS F =		WEAK EXPLOSION,	145
AI 7090 F2 RS PLT=				ARES2, RESONANCE INTEGRAL X-SECTION CALC	89
CCC 1604 F63 RS PLT=				ARES2, RESONANCE INTEGRAL X-SECTION CALC	89
R ANL 3600 F63 RSBP T=				ARGUS, TRANSIENT TEMPERATURE CALC CYLINDER	152
CCDE CRNL 7090 F+FAP RS P T=				ASSAULT, 2-D MULTI-GP DIFFUSION DEPLETION	240
PW 1604 F+CDP RS F T=	LAG,			ASSEMBLER FOR FLOCO2 INSTRUCTION SET	186
RS P =	GRACE1, GAMMA-RAY	ATTENUATION SLAB GEOMETRY	AI 7090 F2		45

3	RS P = GRACE1, GAMMA-RAY ATTENUATION SLAB GEOMETRY	CDC	1604 F6	45			
	RS P = GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE GEOM	AI	7090 F2	46			
3	RS P = GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE GEOM	CDC	1604 F6	46			
VER,	ENERGY INTERVAL X-SECTION AVERAGING	GA	7044 F4	RS P = GA	218		
	GEC 625 F4	RS P =	AVOID, ANNULAR VOID X-SECTION CALCULATION		276		
ERE	CDC 3600 F63	RSBP =	AX1, COUPLED NEUTRONICS-HYDRODYNAMICS SPH		102		
DLES	LASL 7094 F2	RS P =	AXFLU, HEAT TRANSFER MOLTEN FUEL TUBE BUN		182		
T=	SAFE-PCRS, STRESS ANALYSIS	GA	7044 F4	RS P	250		
	SAFE-AXISYM, STRESS ANALYSIS	GA	7044 F4	RS P T=	251		
SPH	PM 1604 F63	RS P =	AX-TNT, COUPLED NEUTRONICS-HYDRODYNAMICS		191		
DLES	LASL 7094 F2	RS P =	AXTRM, HEAT TRANSFER SOLID FUEL TUBE BUN		183		
TION	AI 7090 F2	RS P =	BAM, S4 CYL CELL CODE AND TEMPEST COMBINA		108		
LES	14.5-14,500PSIA 32-472DEGF	BAPL 2000 F4	RS =	WATER, STEAM TAB	R267		
	SWELLING TEMPERATURE STUDY	BAPL 2000 F4	RS P =	FIGAO, LSBR FUEL	R272		
ALYSIS	CYL FUEL ELEMENT	BAPL 6600 F4	RS T=	CYGRD2, STRESS A	R266		
SPACE-TIME	DIFFUSION 3-GEOM	BAPL 6600 F4	RS P T=	WIGL2, 1-D 2-GP	R274		
	FEW-GP DIFFUSION DEPLETION	BAPL 6600 F+ASC	RS T=	POQ7, 1,2 OR 3-D	R275		
GP	DISCRETE ORIGINATE PROGRAM	BEC 625 F4	RS P T=	DTF4, 1-D MULTI-	209		
4	RS P = COMBCO, COMBINED	B-W MULTI-LEVEL CONVOLUTION	PP	7040 F	203		
	RS P = EXT, X-SECTIONS FROM	B-W RESONANCE PARAMETERS	NAL	7094 F2	238		
	P = FASDOP, X-SECTIONS FROM	B-W RESONANCE DATA	GA	7044 F4	RS	216	
NSFER	GA 7044 F4	RS T=	BLOOST5, POINT-KINETICS WITH 2-D HEAT TRA		205		
KE	7094 F2	RSBP T=	PTH1, BLOWDOWN PRESSURE TEMPERATURE HISTORY		155		
	RSBP T= SATURATED BLOWDOWN1,	BLOWDOWN ANALYSIS LOFT	KE	7094 F+MAP	200		
	7094 F+MAP	RSBP T= SATURATED	BLOWDOWN1, BLOWDOWN ANALYSIS LOFT	KE	200		
	RSBP = WATER-HAMMER, LIQUID	BLOWDOWN ANALYSIS LOFT	KE	3600 F2	276		
	RS P = WATER-HAMMER, LIQUID	BLOWDOWN ANALYSIS LOFT	UG	360 F4	278		
SERVICE	ROUTINES ENDF TAPES	BNL 7090 F+MAP	RS P T=	DFSR, DATA FILE	236		
CAL	EXPERIMENT ANALYSIS SYSTEM	BNL-SRL 7090 F2	RS PLT=	HAMMER, CRITI	277		
CAL	EXPERIMENT ANALYSIS SYSTEM	BNL-SRL 360 F4	RS PLT=	HAMMER, CRITI	277		
P	CONSTANT CALC 0 TO 10 MEV	BNWL 1107 F4	RS PLT=	GAMTEC2, MULTI-G	185		
P	DIFFUSION SLAB CYL SPHERE	BNWL 1107 F4	RS P T=	KFK, 1-D MULTI-G	241		
	MULTI-GP DOUBLE SN APPROX	BNWL 7090 FLOC	RSBP T=	GE-HAPG-S13, 1-D	75		
GN	MULTIGROUP SLAB GEOMETRY	BNWL 7090 F2	RSBP T=	MAC, SHIELD DESI	143		
P	CONSTANT CALC 0 TO 10 MEV	BNWL 7090 F+MAP	RS FLT=	GAMTEC2, MULTI-G	185		
, PLANE	STRESS ANALYSIS OF 2-D	BODIES	GA	7044 F4	RS P T=	PIZZA	230
NE, PLANE	STRESS ANALYSIS, 2-D	BODIES	GA	1108 F4	RS P =	SAFE-PLA	252
BATION	FOR AIM AND FOG CODES	BOEC 360 F4	RS P =	PERT, 1-D PERTUR		30	
L	NEUTRON SPECTRUM X-SECTIONS	BOEC 360 F4	RS PLT=	TEMPEST2, THERMA		50	
I-GP	DIFFUSION SLAB CYL SPHERE	BOEC 360 F4	RS P T=	FAINCS, 1-D MULTI		120	
NT	AGN 7090 F2	RS P =	BOUNCE, FLUX DIST IN MULTI-FIN FUEL ELEME		237		
HEAT	TRANSFER MOLTEN FUEL TUBE	BUNDLES	LASL 7094 F2	RS P =	AXFLU,	182	
HEAT	TRANSFER SOLID FUEL TUBE	BUNDLES	LASL 7094 F2	RS P =	AXTRM,	183	
T=	DOB, 2-D FEW-GP DIFFUSION	BURNUP RZ GEOMETRY	GA	7090 F+MAP	RSBP	99	
LT=	LASER, SPECTRUM CALC WITH	BURNUP CYL LATTICE	WAPD 7094 F+MAP	RS P		249	
	UM 7090 MAD	RSB =	BURP1, DETECTOR EFFICIENCY POINT SOURCE			164	
	UM 7090 MAD	RSB =	BURP2, DETECTOR EFFICIENCY DISK SOURCE			165	
	UM 7090 MAD	RSB =	BURP3, DETECTOR EFFICIENCY POINT SOURCE			166	
TAL	UM 7090 MAD	RSB =	BURP4, GAMMA-RAY PHOTOFRACTION SOLID CRYST			169	
AL	UM 7090 MAD	RSB =	BURP5, GAMMA-RAY PHOTOFRACTION WELL CRYST			170	
LIB	AI 360 F4	RSBP T=	CAESAR4/LIBLST, 1-D MULTI-GP DIFFUSION +			270	
AT, VIEW	FACTOR SHIELDING CODE	CAVITY GEOM	GA	1108 F4	RS P T=	MUSC	259
FESHBACH	INELASTIC SCATTERING	CDC	1604 F63	RS P =	HAFFER, HAUSER-		14
DIFFUSION	SLAB CYLINDER SPHERE	CDC	1604 F63	RS P T=	FOG, 1-D FEW-GP		28
GP	DIFFUSION SLAB CYL SPHERE	CDC	1604 F63	RS PLT=	AIM6, 1-D MULTI-		29
BATION	FOR AIM AND FOG CODES	CDC	1604 F63	RS =	PERT, 1-D PERTUR		30
-GROUP	DIFFUSION XYZ GEOMETRY	CDC	1604 F63	RS P T=	WHIRLAWAY, 3-D 2		32
ON	SPECTRUM X-SECTION CALC	CDC	1604 F63	RS PLT=	GAM1, FAST NEUTR		33
-GROUP	DIFFUSION SLAB CYLINDER	CDC	1604 F63	RS P T=	20GRAND, 2-D FEW		40
Y	ATTENUATION SLAB GEOMETRY	CDC	1604 F63	RS P =	GRACE1, GAMMA-RA		45
Y	ATTENUATION CYL SPHERE GEOM	CDC	1604 F63	RS P =	GRACE2, GAMMA-RA		46

DOSE RATE FROM A CLOUD	CDC 1604 F63	RS P = CLOUD, GAMMA-RAY	47
L NEUTRON SPECTRUM X-SECTIONS	CDC 1604 F63	RS PLT= TEMPEST2, THERMA	50
ON SPECTRUM X-SECTION CALC	CDC 1604 F63	RS PLT= FORM, FAST NEUTR	51
, 1-D 1-GP S4 APPROXIMATION	CDC 1604 F63	RS = S4 CYL CELL CODE	53
1GROUP DIFFUSION DEPLETION	CDC 1604 F63	RS LT= SIZZLE, 1-D MULT	58
2-GP DIFFUSION CYLINDER SLAB	CDC 1604 F63	RS P T= EQUIPOISE3A, 2-D	87
INTEGRAL X-SECTION CALC	CDC 1604 F63	RS PLT= ARES2, RESONANCE	89
TRONICS-HYDRODYNAMICS SPHERE	CDC 3600 F63	RSBP = AX1, COUPLED NEU	102
GP DIFFUSION SLAB CYL SPHERE	CDC 1604 F63	RS PLT= FAIR, 1-D MULTI-	120
IVITY AND POWER DISTRIBUTION	CDC 3600 F63	RSBP T= FLARE, 3-D REACT	167
RESONANCE INTEGRAL CALC 2-REG	CELL ANL 3600 F63	RSBP T= RIFF-RAFF,	213
I 7090 F2 RS = S4 CYL	CELL CODE, 1-D 1-GP S4 APPROXIMATION	A	53
DC 1604 F63 RS = S4 CYL	CELL CODE, 1-D 1-GP S4 APPROXIMATION	C	53
090 F2 RS P = BAM, S4 CYL	CELL CODE AND TEMPEST COMBINATION	AI 7	108
PW 1604 F63 RS P T= PIP,	CENTRIFUGAL PUMP IMPELLER DESIGN STUDY		187
DATA AI 7094 F+MAP RS P =	CHAD, LEGENORE COEF CALC FOR ANGULAR DIST		215
= ISOCRUNCH, REACTION DECAY	CHAIN ANALYSIS	GRNL 7090 F2 RS P	180
= ISOCRUNCH, REACTION DECAY	CHAIN ANALYSIS	GRNL 1604 F63 RS P	180
= NUCY, SOLUTION OF NUCLIDE	CHAIN EQUATIONS	GRNL 7090 F2 RSBP	134
= NUCY, SOLUTION OF NUCLIDE	CHAIN EQUATIONS	GRNL 1604 F63 RSBP	134
= DANCORF JR, MODERATOR SPACE	CHORD DIST FUNCT	AEG 7090 F2 RS	150
TIME AI 360 F4 RSB LT=	CLIP, FORM OR THREDES LIBRARY UTILITY	RDV	271
UD, GAMMA-RAY DOSE RATE FROM A CLOUD	AI 7090 F2 RS P = CLO		47
UD, GAMMA-RAY DOSE RATE FROM A CLOUD	CDC 1604 F63 RS P = CLO		47
UD, GAMMA-RAY DOSE RATE FROM A CLOUD	SRL 360 F4 RS P = CLO		47
AI 7090 F2 RS P =	CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD		47
CDC 1604 F63 RS P =	CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD		47
SRL 360 F4 RS P =	CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD		47
PW 1604 F63 RS P =	CNPXNAT, TRANSFER FUNCTION EVALUATION		188
NL 3600 F63 RSBP = COINC,	COINCIDENCE COUNTING DATA REDUCTION	A	248
N ANL 3600 F63 RSBP =	COINC, COINCIDENCE COUNTING DATA REDUCTIO		248
ICN PP 7040 F4 RS P =	COMBCC, COMBINED B-W MULTI-LEVEL CONVOLUT		203
, S4 CYL CELL CODE AND TEMPEST	COMBINATION AI 7090 F2 RS P = BAM		108
7040 F4 RS P = COMBCC,	COMBINED B-W MULTI-LEVEL CONVOLUTION	PP	203
3600 F63 RSBP = NEARREX,	COMPOUND NUCLEUS X-SECTION CALC	ANL	171
RS P T= RATH, 2- OR 3-D HEAT	CONDUCTION LUMPED MASS	LASL 7094 FAP	242
SPHERE LRLL 7090 F2 RS P =	CONEC, COUPLED NEUTRONICS-HYDRODYNAMICS S		129
7044 F4 RS = CORE, CORE	CONFIGURATION FUEL TEMPERATURE CODE	GA	233
FAP RS PLT= GAMTEC2, MULTI-GP	CONSTANT CALC 0 TO 10 MEV	BNWL 7090 F+	185
RS PLT= GAMTEC2, MULTI-GP	CONSTANT CALC 0 TO 10 MEV	BNWL 1107 F4	185
S P = SNC, CALCULATION OF SN	CONSTANTS FOR DSN TEC	Ph 1604 F63 R	189
GN-GAM, FAST SPECTRUM MULTI-GP	CONSTANT CALC AGN	7090 F2 RSBPLT= A	204
44 F4 RS T= PRECON, HIGR	CONTAINMENT PRESSURE POST RUPTURE	GA 70	228
MBCQ, COMBINED B-W MULTI-LEVEL	CONVOLUTION	PP 7040 F4 RS P = CO	203
GA 7044 F4 RS = CORE,	CORE CONFIGURATION FUEL TEMPERATURE CODE		233
RS P = GAZELLE5, GAS-COOLED	CORE THERMAL DESIGN STUDY	GA 7044 F4	232
CODE GA 7044 F4 RS =	CORE, CORE CONFIGURATION FUEL TEMPERATURE		233
= AIMFIRE, URANIUM FUEL CYCLE	COST ANALYSIS	AI 7090 F2 RS P	55
TEAP GENERATOR DESIGN CRITERIA	COSTS GA 7044 F4 RS P T= STNGEN, S		227
RS P = WAMPUK, FUEL CYCLE	COSTS PERFORMANCE STUDY	GA 7044 F4	224
RSBP = NPPFCCP, FUEL CYCLE	COSTS PERFORMANCE DATA	KE 7090 F2	146
RSBP = COINC, COINCIDENCE	COUNTING DATA REDUCTION	ANL 3600 F63	248
CDC 3600 F63 RSBP = AX1,	COUPLED NEUTRONICS-HYDRODYNAMICS SPHERE		102
RLL 7090 F2 RS P = CONEC,	COUPLED NEUTRONICS-HYDRODYNAMICS SPHERE L		129
F2 RS P = WEAK EXPLOSION,	COUPLED NEUTRON-HYDRODYNAMICS	APDA 7094	145
7090 F2 RSB = HATCHET,	COUPLED NEUTRONICS-HYDRODYNAMICS CODE	AGN	153
1604 F63 RS P = AX-TNT,	COUPLED NEUTRONICS-HYDRODYNAMICS SPH	PW	191
APES WAL 7094 F2 RS T=	CPS, SC4020 PLOTS FROM SCISRS X-SECTION T		239
RAM UK-R 7090 F+MAP RSBPLT=	CRAM, 1-D AND 2-D MULTI-GP DIFFUSION PRG		103
STNGEN, STEAM GENERATOR DESIGN	CRITERIA COSTS	GA 7044 F4 RS P T=	227
RL 7090 F2 RS PLT= HAMMER,	CRITICAL EXPERIMENT ANALYSIS SYSTEM	BNL-S	277

RL 360 F4	RS PLT= HAMMER,	CRITICAL EXPERIMENT ANALYSIS SYSTEM BNL-S	277
IS AGN 7090 F2	RS P =	CROC90, ML-1 FLUID FLOW EXPERIMENT ANALYS	154
ION. AI 7090 F2	RS =	CROCK, SPACE POWER PLANT DESIGN OPTIMIZAT	112
PES GA 7044 F4	RSBP T=	CROSSPLCT, SC4020 PLOTS FROM X-SECTION TA	207
7090 F2	RS T= SUMMIT,	CRYSTALLINE SCATTERING KERNEL CALC	56
GAMMA-RAY PHOTOGRAPHY SOLID		CRYSTAL UK 7090 MAD RSB = BURP4,	169
GAMMA-RAY PHOTOGRAPHY WELL		CRYSTAL UM 7090 MAD RSB = BURP5	170
ON PW 1604 F63	RS =	CSP1, SN X-SECTION LIBRARY TAPE PREPARATI	194
ION PW 1604 F63	RS =	CSP2A, SN X-SECTION LIBRARY TAPE PREPARAT	193
DOSE AI 7094 F+FAP	RS PLT=	CURIE/DOSE/THUNDERHEAD, EXTERNAL+INTERNAL	196
= LASL LEAST SQUARES, GENERAL		CURVE FITTING LASL 7094 F4 RS	62
RS P T= REVISED-GAD, FUEL		CYCLE ANALYSIS W/REFUELING GA 7044 F4	223
PLT= CYCLOPS1, THERMODYNAMIC		CYCLE ANALYSIS AI 7094 F2 RS	244
F4 RS P T= GARGOYLE, FUEL		CYCLE ANALYSIS PARTIAL REFUEL GA 7044	260
RS P = AIRFIRE, URANIUM FUEL		CYCLE COST ANALYSIS AI 7090 F2	55
0 F2 RSEP = NPRECCP, FUEL		CYCLE COSTS PERFORMANCE DATA KE 709	146
44 F4 RS P = WAPPUM, FUEL		CYCLE COSTS PERFORMANCE STUDY GA 70	224
AI 7094 F2	RS PLT=	CYCLOPS1, THERMODYNAMIC CYCLE ANALYSIS	244
BAPL 6600 F4	RS T=	CYGR02, STRESS ANALYSIS CYL FUEL ELEMENT	R266
E3, 2-D 2-GROUP DIFFUSION SLAB		CYL ORNL 7090 F2 RS P T= EQUIP01S	39
AI 7090 F2	RS = S4	CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION	53
CDC 1604 F63	RS = S4	CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION	53
7090 F2	RS P = BAM, S4	CYL CELL CODE AND TEMPEST COMBINATION AI	106
T= CYGR02, STRESS ANALYSIS		CYL FUEL ELEMENT BAPL 6600 F4 RS	R266
SER, SPECTRUM CALC WITH BURNUP		CYL LATTICE WAPD 7094 F+FAP RS PLT= LA	249
ULTI-GP FLUX SYNTHESIS PROGRAM		CYL PW 1604 F63 RS T= 2DXYL, 3-D M	192
6, 1-D MULTI-GP DIFFUSION SLAB		CYL SPHERE AI 7090 F+FAP RS PLT= AIM	29
6, 1-D MULTI-GP DIFFUSION SLAB		CYL SPHERE CDC 1604 F63 RS PLT= AIM	29
GRACE2, GAMMA-RAY ATTENUATION		CYL SPHERE GEOM AI 7090 F2 RS P =	46
GRACE2, GAMMA-RAY ATTENUATION		CYL SPHERE GEOM CDC 1604 F63 RS P =	46
R, 1-D MULTI-GP DIFFUSION SLAB		CYL SPHERE AI 7090 F+FAP RS LT= ULCE	118
R, 1-D MULTI-GP DIFFUSION SLAB		CYL SPHERE AI 7090 F+FAP RS LT= FAI	120
S, 1-D MULTI-GP DIFFUSION SLAB		CYL SPHERE CDC 1604 F63 RS PLT= FAI	120
S, 1-D MULTI-GP DIFFUSION SLAB		CYL SPHERE BOEC 360 F4 RS P T= FAI#C	120
N, 1-D MULTI-GP SN APPROX SLAB		CYL SPHERE UK-W 7090 F2 RS P T= W-CS	132
N, 1-D MULTI-GP SN APPROX SLAB		CYL SPHERE PW 1604 LAG1 RS P = MGCS	211
A, 1-D MULTI-GP DIFFUSION SLAB		CYL SPHERE BNWL 1107 F4 RS P T= HF	241
I, 1-D MULTI-GP DIFFUSION SLAB		CYL SPHERE ANL 3600 F63 RS P T= MACH	262
FIRE2, 1-D AGE-DIFFUSION SLAB		CYLINDER SPHERE ROA 360 F4 RS PLT=	9
FOG, 1-D FEW-GP DIFFUSION SLAB		CYLINDER SPHERE AI 7090 F2 RS P T=	28
FOG, 1-D FEW-GP DIFFUSION SLAB		CYLINDER SPHERE CDC 1604 F63 RS P T=	28
, 2-D FEW-GROUP DIFFUSION SLAB		CYLINDER ORNL 7090 F2 RS P T= 20GRAND	40
, 2-D FEW-GROUP DIFFUSION SLAB		CYLINDER CDC 1604 F63 RS P T= 20GRAND	40
QUIP01SE3A, 2-D 2-GP DIFFUSION		CYLINDER SLAB ORNL 7090 F2 RS P T= E	87
QUIP01SE3A, 2-D 2-GP DIFFUSION		CYLINDER SLAB CDC 1604 F63 RS P T= E	87
C, 1-D FEW-GP SN APPROXIMATION		CYLINDER PP 7040 F4 RS P T= TOFI	146
C, 1-D FEW-GP SN APPROXIMATION		CYLINDER PP 7090 F2 RS P T= TGPI	146
US, TRANSIENT TEMPERATURE CALC		CYLINDER ANL 3600 F63 RSBP T= ARG	152
UTRON PENETRATION CALCULATION		DAC 7090 F2 RSBP = LIFRECAN1, PC AE	123
NCT AEG 7090 F2	RS =	DANDOFF JR, MODERATOR SPACE CHORD CIST FU	150
, FUEL CYCLE COSTS PERFORMANCE		DATA KE 7090 F2 RSEP = NPRECCP	146
X-SECTIONS FROM B-W RESONANCE		DATA GA 7044 F4 RS P = FASECCP,	216
LYSIS OF PULSED NEUTRON SOURCE		DATA GESJ 635 F4 RS P T= EXPN, ANA	258
CRE COEF CALC FOR ANGULAR DIST		DATA AI 7094 F+FAP RS P = CHAC, LEGEN	215
BNL 7090 F+FAP RS P T= DESP,		DATA FILE SERVICE ROUTINES ENDF TAPES	236
LASL 7090 F2	RS P T= LPC,	DATA PREPARATION FOR 2-D DESIGN PROGRAMS	234
= COINC, COINCIDENCE COUNTING		DATA REDUCTION ANL 3600 F63 RSEP	246
TRY GA 7090 F+FAP RSEP T=		CEB, 2-D FEW-GP DIFFUSION BURNUP RZ GEOME	99
RS P = ISCRUNCH, REACTION		DECAY CHAIN ANALYSIS CRAL 7090 F2	180
RS P = ISCRUNCH, REACTION		DECAY CHAIN ANALYSIS CRAL 1604 F63	180
MAXIMUM YIELD FROM REACTION CR		DECAY ORNL 1604 F63 RS P = ISOTOPE,	179
CEB, MONTE CARLO SLOWING-DOWN		DENSITY CALC AI 7094 F+FAP RS PLT= 1Y	145

ZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION	AI	7090 F2	RS	LT=	SI	58
ZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION	CDC	1604 F63	RS	LT=	SI	58
ZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION	AI	360 F4	RSBP	T=	SI	58
= FEVER, 1-C FEW-GP DIFFUSION DEPLETION	PROGRAM	GA	7090 F2	RSB	T	117
AD-FEVER, 1-D FEW-GP DIFFUSION DEPLETION	GA	7044 F4	RS	P T=	RELO	221
SSAULT, 2-C MULTI-GP DIFFUSION DEPLETION	CODE	DRNL 7090 F+FAP	RS	P T=	A	240
F-BURN, 1-C MULTI-GP DTF4 WITH DEPLETION	LASL	7030 F4	RS	P T=	DT	269
7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETION	BAPL	6600 F+ASC	RS	T=	PQG	R275
PARD, SPECTRA CALCULATION WITH DEPLETION	WAPD	7090 F+FAP	RSBP	T=	LEC	279
= CROCK, SPACE POWER PLANT DESIGN OPTIMIZATION	AI	7090 F2	RS			112
= SHOCK, SPACE POWER PLANT DESIGN OPTIMIZATION	AI	7090 F2	RS			114
090 F2 RSBPLT= MAC, SHIELD DESIGN MULTIGROUP SLAB GEOMETRY	BNL	7				143
PIP, CENTRIFUGAL PUMP IMPELLER DESIGN STUDY	PW	1604 F63	RS	P T=		187
P T= STMGEM, STEAM GENERATOR DESIGN CRITERIA COSTS	GA	7044 F4	RS			227
ELLES, GAS-COOLED CORE THERMAL DESIGN STUDY	GA	7044 F4	RS	P =	GAZ	232
OPC, DATA PREPARATION FOR 2-D DESIGN PROGRAMS	LASL	7090 F2	RS	P T=		234
THREDES, 1-C FEW-GP DIFFUSION DESIGN SYSTEM	AI	360 F4	RSBP	T=		273
M 7090 MAD RSB = BURP1, DETECTOR EFFICIENCY POINT SOURCE					U	164
M 7090 MAD RSB = BURP2, DETECTOR EFFICIENCY DISK SOURCE					U	165
M 7090 MAD RSB = BURP3, DETECTOR EFFICIENCY POINT SOURCE					U	166
ES BNL 7090 F+FAP RS P T= OFSR, DATA FILE SERVICE ROUTINES ENDF TAP						236
S P T= ZOGRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER	DRNL	7090 F2	R			40
S P T= ZOGRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER	CDC	1604 F63	R			40
S LT= SIZZLE, 1-C MULTIGROUP DIFFUSION DEPLETION	AI	7090 F2	R			58
S LT= SIZZLE, 1-C MULTIGROUP DIFFUSION DEPLETION	CDC	1604 F63	R			58
SBP T= SIZZLE, 1-C MULTIGROUP DIFFUSION DEPLETION	AI	360 F4	R			58
RS P T= EQUIPCISE3A, 2-C 2-GP DIFFUSION CYLINDER SLAB	DRNL	7090 F2				87
RS P T= EQUIPCISE3A, 2-C 2-GP DIFFUSION CYLINDER SLAB	CDC	1604 F63				87
F+FAP RSBP T= CDB, 2-C FEW-GP DIFFUSION BLURUP RZ GEOMETRY	GA	7090				95
T= CRAM, 1-C AND 2-C MULTI-GP DIFFUSION PROGRAM	UK-R	7090 F+FAP	RSBP			102
RSB T= FEVER, 1-C FEW-GP DIFFUSION DEPLETION PROGRAM	GA	7090 F2				117
P RS LT= ULCER, 1-C MULTI-GP DIFFUSION SLAB CYL SPHERE	AI	7090 F+FAP				118
AP RS LT= FAIP, 1-C MULTI-GP DIFFUSION SLAB CYL SPHERE	AI	7090 F+FAP				120
RS PLT= FAIP, 1-C MULTI-GP DIFFUSION SLAB CYL SPHERE	CDC	1604 F63				120
RS P T= FAIMCS, 1-C MULTI-GP DIFFUSION SLAB CYL SPHERE	BECC	360 F4				120
T= EXTERMINATOR, 2-C MULTI-GP DIFFUSION PROGRAM	CRNL	7090 F+FAP	RS	P		156
= EXTERMINATOR2, 2-C MULTI-GP DIFFUSION PROGRAM	CRNL	360 F4	RS	P T		156
F2 RS P T= FCG, 1-C FEW-GP DIFFUSION SLAB CYLINDER SPHERE	AI	7090				28
F63 RS P T= FCG, 1-C FEW-GP DIFFUSION SLAB CYLINDER SPHERE	CDC	1604				28
AP RS PLT= AIM6, 1-C MULTI-GP DIFFUSION SLAB CYL SPHERE	AI	7090 F+FAP				29
RS PLT= AIM6, 1-C MULTI-GP DIFFUSION SLAB CYL SPHERE	CDC	1604 F63				29
S P T= WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY	DRNL	7090 F2	R			32
S P T= WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY	CDC	1604 F63	R			32
P T= EQUIPCISE3, 2-D 2-GROUP DIFFUSION SLAB CYL	DRNL	7090 F2	RS			39
R1-CUR, TIME-DEP 2-C MULTI-GP DIFFUSION	WAL	7090 F+FAP	RS	F T=	VA	212
RS P T= GASF2, 1-C FEW-GP DIFFUSION POWER DIST SEARCH	GA	7044 F4				220
P T= RELOCAD-FEVER, 1-C FEW-GP DIFFUSION DEPLETION	GA	7044 F4	RS			221
RSBP T= GAMBLE4, 2-C MULTI-GP DIFFUSION XY RZ GEOMETRY	GA	7044 F+FAP				222
RS P T= TEMCG, 1-C FEW-GP DIFFUSION TEMP COEF CALC	GA	7044 F4				225
RS P T= ASSAULT, 2-C MULTI-GP DIFFUSION DEPLETION CODE	DRNL	7090 F+FAP				240
RS P T= HFA, 1-C MULTI-GP DIFFUSION SLAB CYL SPHERE	BNL	1107 F4				241
RS P T= MACH1, 1-C MULTI-GP DIFFUSION SLAB CYL SPHERE	ANL	3600 F63				262
P T= VARI-CUR3, 2-C MULTI-GP DIFFUSION XY RZ RTH	WAL	7094 F4	RS			264
CAESAR4/LIBLST, 1-C MULTI-GP DIFFUSION + LIB	AI	360 F4	RSBP	T=		270
RSBP T= THREDES, 1-C FEW-GP DIFFUSION DESIGN SYSTEM	AI	360 F4				273
T= WIGL2, 1-C 2-GP SPACE-TIME DIFFUSION 3-GEOM	BAPL	6600 F4	RS	P		R274
T= PDC7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETION	BAPL	6600 F+ASC	RS			R275
RS PLT= DTF, 1-C MULTIGROUP DISCRETE COORDINATE CALC	LNC	1604 F63				144
RS PLT= DTF2, 1-C MULTI-GP DISCRETE COORDINATE CALC	AI	7090 F2				151
RSBP	ANISN, 1-C MULTI-GP DISCRETE COORDINATE CALC	AI	360 F4			151
3 RS = ZCF, 2-C MULTI-GP DISCRETE COORDINATE CALC	LNC-LASL	1604 F63				172

RS P T=	DTF4, 1-D MULTI-GP	DISCRETE ORDINATE PROGRAM	LASL 7030 F4	209
RS P T=	DTF4, 1-D MULTI-GP	DISCRETE ORDINATE PROGRAM	LRC 7094 F4	209
RS P T=	DTF4, 1-D MULTI-GP	DISCRETE ORDINATE PROGRAM	LASL 6600 F4	209
RS P T=	DTF4, 1-D MULTI-GP	DISCRETE ORDINATE PROGRAM	BEC 625 F4	209
RS P T=	DTF4, 1-D MULTI-GP	DISCRETE ORDINATE PROGRAM	ANL 360 F4	209
=	BURP2, DETECTOR EFFICIENCY	DISK SOURCE	UM 7090 MAD RSB	165
	GESJ 2000 F2	RS P =	DOPIE, RESOLVED RESONANCE X-SECTION CALC	177
=	SPARTA, SPATIALLY-AVERAGED	DOPPLER EFFECTS	GESJ 2000 F2 RS P	178
THUNDERHEAD, EXTERNAL+INTERNAL	DOSE AI	7094 F+FAP RS PLT=	CURIE/DOSE/	196
DE, SHIELD WEIGHT OPTIMIZATION	DOSE CALC	AI 7094 F2	RS P = SH	197
/DOSET, HTGR ACCIDENT ANALYSIS	DOSE CALC	GA 1108 F4	RS T= GADOSE	261
2 RS P =	CLOUD, GAMMA-RAY	DOSE RATE FROM A CLOUD	AI 7090 F	47
63 RS P =	CLOUD, GAMMA-RAY	DOSE RATE FROM A CLOUD	CDC 1604 F	47
4 RS P =	CLOUD, GAMMA-RAY	DOSE RATE FROM A CLOUD	SRL 360 F	47
7090 F2 RS =	FARSEIA,	DOSE RATE FROM SNAP SHIELD LEAKAGE	AI	91
7090 F2 RS P =	RATRAP,	DOSE RATE CALCULATION SNAP GEOMETRY	AI	141
7090 F2 RS =	MORTIMER,	DOSE RATE CALCULATION SNAP GEOMETRY	AI	142
RS P =	MIST, 1-D FEW-GP SN	DOUBLE SN APPROX SLAB GEOM PP	7090 F2	59
T=	GE-HAPO-S13, 1-D MULTI-GP	DOUBLE SN APPROX	BNWL 7090 FLOCC RSBP	75
RAMS LASL 7090 F2	RS P T=	DPC, DATA PREPARATION FOR 2-D DESIGN PROG		234
EFFECTIVE X-SECTION CALC FROM	DSN OUTPUT	PW 1604 LAG1	RS P = DTX,	210
ALCULATION OF SN CONSTANTS FOR	DSN TDC	PW 1604 F63	RS P = SNC, C	189
AI 7090 F2	RS PLT=	DTF2, 1-D MULTI-GP DISCRETE ORDINATE CALC		151
S P T=	DTF-BURN, 1-D MULTI-GP	DTF4 WITH DEPLETION	LASL 7030 F4	269
RAM LASL 7030 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROG		209
RAM LRC 7094 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROG		209
RAM LASL 6600 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROG		209
RAM BEC 625 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROG		209
RAM ANL 360 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROG		209
N LASL 7030 F4	RS P T=	DTF-BURN, 1-D MULTI-GP DTF4 WITH DEPLETION		269
C UNC 1604 F63	RS PLT=	DTF, 1-D MULTIGROUP DISCRETE ORDINATE CALC		144
TPUT PW 1604 LAG1	RS P =	DTX, EFFECTIVE X-SECTION CALC FROM DSN CU		210
S =	WED, W-DSN OUTPUT TAPE	EDIT REACTION RATES	UK-W 7090 F2	133
MAD RSB =	BURP1, DETECTOR	EFFICIENCY POINT SOURCE	UM 7090	164
MAD RSB =	BURP2, DETECTOR	EFFICIENCY DISK SOURCE	UM 7090	165
MAD RSB =	BURP3, DETECTOR	EFFICIENCY POINT SOURCE	UM 7090	166
S PLT=	AILMOE, X-SECTION CALC	ELASTIC SCAT RESONANCES	AI 7090 F+FAP R	147
S PLT=	AILMOE, X-SECTION CALC	ELASTIC SCAT RESONANCES	AI 360 F4	147
GA 7044 F4	RS P T=	ELBOW, FUEL ELEMENT STRESS ANALYSIS STUDY		229
SR, DATA FILE SERVICE ROUTINES	ENDF TAPES	BNL 7090 F+FAP RS P T=	DF	236
A 7044 F4	RS P =	GAYER,		218
ATION GEV 7094 F+FAP	RS P T=	EPITHERMOS, SPECTRUM AND X-SECTION CALCUL		201
P T=	REAX, RESOLVED RESONANCE	EPITHERMAL X-SECTIONS	GESJ 635 F4	257
L ORNL 7090 F2	RS P T=	EQUIPOISE3, 2-D 2-GROUP DIFFUSION SLAB CY		39
SLAB ORNL 7090 F2	RS P T=	EQUIPOISE3A, 2-D 2-GP DIFFUSION CYLINDER		87
SLAB CDC 1604 F63	RS P T=	EQUIPOISE3A, 2-D 2-GP DIFFUSION CYLINDER		87
=	CMPXNAT, TRANSFER FUNCTION	EVALUATION	PW 1604 F63 RS P	188
RS P T=	FORE, FAST REACTOR	EXCURSION CALCULATIONS	GESJ 2000 F4	174
RS P T=	FORE2, FAST REACTOR	EXCURSION CALCULATIONS	GESJ 635 F4	174
P =	CROC90, ML-1 FLUID FLOW	EXPERIMENT ANALYSIS	AGN 7090 F2	154
2 RS PLT=	HAMMER, CRITICAL	EXPERIMENT ANALYSIS SYSTEM	BNL-SRL 7090 F	277
4 RS PLT=	HAMMER, CRITICAL	EXPERIMENT ANALYSIS SYSTEM	BNL-SRL 360 F	277
APDA 7094 F2	RS P =	WEAK		145
ATA GESJ 635 F4	RS P T=	EXPN, ANALYSIS OF PULSED NEUTRON SOURCE		258
RAM ORNL 7090 F+FAP	RS P T=	EXTERMINATOR, 2-D MULTI-GP DIFFUSION PROG		156
GRAM ORNL 360 F4	RS P T=	EXTERMINATOR2, 2-D MULTI-GP DIFFUSION PRO		156
PLT=	CURIE/DOSE/THUNDERHEAD,	EXTERNAL+INTERNAL DOSE	AI 7094 F+FAP RS	196
TERS WAL 7094 F2	RS P =	EXT, X-SECTIONS FROM B-W RESONANCE PARAME		238
FUSION SLAB: CYLINDER	ORNL 7090 F2	RS P T=	20GRAND, 2-D FEW-GROUP DIF	40
ION SLAB GEOMETRY	AI 7090 F2	RS P =	GRACE1, GAMMA-RAY ATTENUAT	45
ION CYL SPHERE GEOM	AI 7090 F2	RS P =	GRACE2, GAMMA-RAY ATTENUAT	46

FROM A CLOUD	AI	7090 F2	RS P =	CLOUD, GAMMA-RAY DOSE RATE	47
ATURE VOID FRACTION	AI	7090 F2	RS =	FUGUE, STEADY-STATE TEMPER	48
M X-SECTION CALC	AI	7090 F2	RS PLT=	FORM, FAST NEUTRON SPECTRU	51
ATION SLAB GEOMETRY	AI	7090 F2	RS =	SAIL, 1-D 1-GP SN APPROXIM	52
S4 APPROXIMATION	AI	7090 F2	RS =	S4 CYL CELL CODE, 1-D 1-GP	53
E COST ANALYSIS	AI	7090 F2	RS P =	AIMFIRE, URANIUM FUEL CYCL	55
RING KERNEL CALC	GA	7090 F2	RS T=	SUMMIT, CRYSTALLINE SCATTE	56
FUSION DEPLETION	AI	7090 F2	RS LT=	SEIZLE, 1-D MULTIGROUP DIF	58
SA APPROX SLAB GEGM	PP	7090 F2	RS P =	MIST, 1-D FEW-GP SA DCUBLE	59
USTON CYLINDER SLAB	ORNL	7090 F2	RS P T=	EQUIPOISE3A, 2-D 2-GP DIFF	87
X-SECTION CALC	AI	7090 F2	RS PLT=	ARES2, RESONANCE INTEGRAL	89
AP SHIELD LEAKAGE	AI	7090 F2	RS =	FARSE1A, DOSE RATE FROM SK	91
TEMPEST COMBINATION	AI	7090 F2	RS P =	DAM, S4 CYL CELL CODE AND	108
TOR FINS SNAP GEGM	AI	7090 F2	RS =	SCARF2, SCATTER FROM RADIA	110
SNAP GEOMETRY	AI	7090 F2	RS =	SCAR1, SCATTER FROM A RING	111
ESIGN OPTIMIZATION	AI	7090 F2	RS =	CROCK, SPACE POWER PLANT D	112
ESIGN OPTIMIZATION	AI	7090 F2	RS =	SHOCK, SPACE POWER PLANT D	114
N DEPLETION PROGRAM	GA	7090 F2	RSB T=	FEVER, 1-D FEW-GP DIFFUSIO	117
KINETICS W/FEEDBACK	AI	7090 F2	RS =	AIREK3, SPACE-INDEPENDENT	121
TICS SNAP GEOMETRY	AI	7090 F2	RS =	SNAPKINS5A, 1-REGION KINE	122
TRATION CALCULATION	DAC	7090 F2	RSBP =	LIPRECANI, MC NEUTRON PENE	123
HYDRODYNAMICS SPHERE	LRLL	7090 F2	RS P =	CONEC, COUPLED NEUTRONICS-	129
ROX SLAB CYL SPHERE	UK-W	7090 F2	RS P T=	W-DSN, 1-D MULTI-GP SN APP	132
T REACTION RATES	UK-W	7090 F2	RS =	WED, W-DSN OUTPUT TAPE EOI	133
CHAIN EQUATIONS	ORNL	7090 F2	RSBP =	NUCY, SOLUTION OF NUCLIDE	134
S HETEROGENEOUS CALC	FMA	7090 F2	RSBP =	HERESV1, LATTICE PARAMETER	136
IGN SNAP GEOMETRY	AI	7090 F2	RS P =	RATRAP, DOSE RATE CALCULAT	141
ATION SNAP GEOMETRY	AI	7090 F2	RS =	MORTIMER, DOSE RATE CALCUL	142
OP SLAB GEOMETRY	BNWL	7090 F2	RSBPLT=	MAC, SHIELD DESIGN MULTIGR	143
UTRON-HYDRODYNAMICS	APDA	7094 F2	RS P =	WEAK EXPLOSION, COUPLED NE	145
PERFORMANCE DATA	KE	7090 F2	RSBP =	NPRFCOP, FUEL CYCLE COSTS	146
XIMATION CYLINDER	PP	7090 F2	RS P T=	TOPIC, 1-D FEW-GP SN APPRO	148
E CHORD DIST FUNCT	AEG	7090 F2	RS =	DANCCFF JR, MODERATOR SPAC	150
E ORINATE CALC	AI	7090 F2	RS PLT=	DTF2, 1-D MULTI-GP DISCRET	151
S-HYDRODYNAMICS CODE	AGN	7090 F2	RSB =	HATCHET, COUPLED NEUTRONIC	152
PERIMENT ANALYSIS	AGN	7090 F2	RS P =	CROC50, ML-1 FLUID FLOW EX	154
MPERATURE HISTORY	KE	7094 F2	RSBP T=	PTH1, BLOWDOWN PRESSURE TE	155
IMATION RZ GEOMETRY	LRLL	709 F2	RS =	FIRM, 2-D FEW-GP S4 APPROX	7
SLAB CYLINDER SPHERE	AI	7090 F2	RS P T=	FOG, 1-D FEW-GP DIFFUSION	28
AIM AND FOG CODES	AI	7090 F2	RS =	PERT, 1-D PERTURBATION FOR	30
FUSION XYZ GEOMETRY	ORNL	7090 F2	RS P T=	WHIRLAWAY, 3-D 2-GROUP DIF	32
M X-SECTION CALC	GA	7090 F2	RS PLT=	GAM1, FAST NEUTRON SPECTRU	33
EFUSION SLAB CYL	ORNL	7090 F2	RS P T=	EQUIPOISE3, 2-D 2-GROUP DI	39
L X-SECTION CALC	GESJ	2000 F2	RS P =	RAPTIRE, RESONANCE INTEGRA	176
X-SECTION CALC	GESJ	2000 F2	RS P =	DOPIE, RESOLVED RESONANCE	177
DOPLER EFFECTS	GESJ	2000 F2	RS P =	SPARTA, SPATIALLY-AVERAGED	178
CHAIN ANALYSIS	ORNL	7090 F2	RS P =	ISOCRUNCH, REACTION DECAY	180
N FUEL TUBE BUNDLES	LASL	7094 F2	RS P =	AXFLL, HEAT TRANSFER MOLTE	182
C FUEL TUBE BUNDLES	LASL	7094 F2	RS P =	AXTHRM, HEAT TRANSFER SOLI	183
ZATION DOSE CALC	AI	7094 F2	RS P =	SHOE, SHIELD WEIGHT OPTIMI	197
-STATE HEAT TRANSFER	AI	7094 F2	RS P T=	HEATING2, TRANSIENT STEADY	198
TI-GP CONSTANT CALC	AGN	7090 F2	RSBPLT=	AGN-GAM, FAST SPECTRUM MUL	204
2-D DESIGN PROGRAMS	LASL	7090 F2	RS P T=	DPC, DATA PREPARATION FOR	234
-PIN FUEL ELEMENT	AGN	7090 F2	RS P =	BOUNCE, FLUX DIST IN MULTI	237
ESONANCE PARAMETERS	WAL	7094 F2	RS P =	EXT, X-SECTIONS FROM B-W R	238
SRS X-SECTION TAPES	WAL	7094 F2	RS T=	CPS, SC4020 PLOTS FROM SCI	239
P TRANSFER MATRICES	AGN	7090 F2	RS P T=	AGN-SIGMA, CALC OF MULTI-G	243
CLE ANALYSIS	AI	7094 F2	RS PLT=	CYCLEPS1, THERMODYNAMIC CY	244
2-D 2-PHASE FLOW	AI	7094 F2	RS P =	FLOW-MODEL, MULTI-CHANNEL	246
AL MODEL X-SECTIONS	AI	7094 F2	RS P T=	2PLUS, NON-SPHERICAL OPTIC	254
OW AND HEAT TRANSFER	AI	7094 F2	RS P T=	TRANS-FUGUE1, TRANSIENT FL	268

T ANALYSIS SYSTEM BNL-SRL	7050	F2	RS PLT*	HAMMER, CRITICAL EXPERIMEN	277
OWA ANALYSIS LOFT KE	3600	F2	RSBP =	WATER-HAMMER, LIQUID BLOWD	278
FROM A CLOUD SRL	360	F4	RS P =	CLOUD, GAMMA-RAY DOSE RATE	47
SPECTRUM X-SECTIONS BCEC	360	F4	RS PLT=	TEMPEST2, THERMAL NEUTRON	50
FUSION DEPLETION AI	360	F4	RSBP T=	SIZZLE, 1-D MULTIGROUP DIF	58
L CURVE FITTING LASL	7094	F4	RS =	LASL LEAST SQUARES, GENERA	62
SION SLAB CYL SPHERE BCEC	360	F4	RS P T=	FAIMCS, 1-D MULTI-GP DIFFU	120
KINETICS W/FEEDBACK ROA	360	F4	RS P =	AIREK3, SPACE-INDEPENDENT	121
STIC SCAT RESONANCES AI	360	F4	RS PLT=	AILMCE, X-SECTION CALC ELA	147
XIMATION CYLINDER PP	7040	F4	RS P T=	TOPIC, 1-D FEW-GP SN APPRO	148
TE ORDINATE CALC AI	360	F4	RSBP LT=	ANISH, 1-D MULTI-GP DISCRE	151
P DIFFUSION PROGRAM ORNL	360	F4	RS P T=	EXTERMINATOR2, 2-D MULTI-G	156
INETICS W/FEEDBACK AI	360	F4	RSBP T=	AIRDS, SPACE-INDEPENDENT K	163
POWER DISTRIBUTION GESJ	635	F4	RS P T=	FLARE, 3-D REACTIVITY ANC	167
VERSE KINETICS CALC WAL	7094	F4	RS =	R102, SPACE-INDEPENDENT IN	168
ON CALCULATIONS GESJ	2000	F4	RS P T=	FORE, FAST REACTOR EXCURSI	174
ION CALCULATIONS GESJ	635	F4	RS P T=	FORE2, FAST REACTOR EXCURS	174
LAB CYLINDER SPHERE ROA	360	F4	RS PLT=	FIRE2, 1-D AGE-DIFFUSION S	9
AIM AND FCG CODES BCEC	360	F4	RS P =	PERT, 1-D PERTURBATION FOR	30
CALC O TO 10 MEV BNWL	1107	F4	RS PLT=	GAMTEC2, MULTI-GP CONSTANT	185
-LEVEL CONVOLUTION PP	7040	F4	RS P =	COMBCO, COMBINED B-W MULTI	203
TH 2-D HEAT TRANSFER GA	7044	F4	RS T=	BLOOST5, POINT-KINETICS WI	205
OM X-SECTION TAPES GA	7044	F4	RSBP T=	CROSSPLOT, SC4020 PLOTS FR	207
E ORDINATE PROGRAM LASL	7030	F4	RS P T=	DTF4, 1-D MULTI-GP DISCRET	209
E ORDINATE PROGRAM LRC	7094	F4	RS P T=	DTF4, 1-D MULTI-GP DISCRET	209
E ORDINATE PROGRAM LASL	6600	F4	RS P T=	DTF4, 1-D MULTI-GP DISCRET	209
E ORDINATE PROGRAM BEC	625	F4	RS P T=	DTF4, 1-D MULTI-GP DISCRET	209
E ORDINATE PROGRAM ANL	360	F4	RS P T=	DTF4, 1-D MULTI-GP DISCRET	209
W RESONANCE DATA GA	7044	F4	RS P =	FASDCP, X-SECTIONS FROM B-	216
LC FOR ANGULAR DIST GA	7044	F4	RS P =	LEGCECF3, LEGENDRE COEF CA	217
ECTION AVERAGING GA	7044	F4	RS P =	GAVER, ENERGY INTERVAL X-S	218
N POWER DIST SEARCH GA	7044	F4	RS P T=	GASP2, 1-D FEW-GP DIFFUSIO	220
IFFUSION DEPLETION GA	7044	F4	RS P T=	RELOAD-FEVER, 1-D FEW-GP C	221
ALYSIS W/REFUELING GA	7044	F4	RS P T=	REVISED-GAD, FUEL CYCLE AN	223
PERFORMANCE STUDY GA	7044	F4	RS P =	WAMPLM, FUEL CYCLE COSTS P	224
N TEMP COEF CALC GA	7044	F4	RS P T=	TEMCC, 1-D FEW-GP DIFFUSIO	225
SIGN CRITERIA COSTS GA	7044	F4	RS P T=	STMGEN, STEAM GENERATOR DE	227
RESSURE POST RUPTURE GA	7044	F4	RS T=	PRECEN, HTGR CONTAINMENT P	228
ANALYSIS STUDY GA	7044	F4	RS P T=	ELBOV, FUEL ELEMENT STRESS	229
IS OF 2-D BODIES GA	7044	F4	RS P T=	PIZZA, PLANE STRESS ANALYS	230
ACTIVITY DIST STUDY GA	7044	F4	RS P =	RAD2, HTGR FISSION PRODUCT	231
THERMAL DESIGN STUDY GA	7044	F4	RS P =	GAZELLES, GAS-COOLED CORE	232
UEL TEMPERATURE CODE GA	7044	F4	RS =	CORE, CORE CONFIGURATION F	233
IONS FOR GAMMA-RAYS GEC	7094	F4	RS P =	GAMMA-P, PRODUCTION X-SECT	235
N SLAB CYL SPHERE BNWL	1107	F4	RS P T=	HFN, 1-D MULTI-GP DIFFUSIO	241
SECTION CALCULATION GA	7044	F4	RS =	FLANGE1, SCATTERING LAW X-	247
AXISYMMETRIC LOAD GA	7044	F4	RS P T=	SAFE-PCRS, STRESS ANALYSIS	250
IS AXISYMMETRIC LOAD GA	7044	F4	RS P T=	SAFE-AXISYM, STRESS ANALYS	251
NALYSIS, 2-D BODIES GA	1108	F4	RS P =	SAFE-PLANE, PLANE STRESS A	252
S THIN SHELLS GA	1108	F4	RS P =	SAFE-SHELL, STRESS ANALYSI	253
NETICS KEX OPTIONS WAL	7094	F4	RS P =	R101, SPACE-INDEPENDENT KI	255
L-HYDRAULIC ANALYSIS GESJ	635	F4	RS P T=	MANTA, STEADY-STATE THERMA	256
PITHERMAL X-SECTIONS GESJ	635	F4	RS P T=	REAX, RESOLVED RESONANCE E	257
EUTRON SOURCE DATA GESJ	635	F4	RS P T=	EXPN, ANALYSIS OF PULSED N	258
ING CODE CAVITY GEOM GA	1108	F4	RS P T=	MUSCAT, VIEW FACTOR SHIELD	259
SIS PARTIAL REFUEL GA	7044	F4	RS P T=	GARGCYL, FUEL CYCLE ANALY	260
T ANALYSIS DOSE CALC GA	1108	F4	RS T=	GADDOSE/DOSET, HTGR ACCIDEN	261
LAW CALCULATION GA	1108	F4	RS P =	GASKET, THERMAL SCATTERING	263
IFFUSION XY RZ RTH WAL	7094	F4	RS P T=	VARI-QUIR3, 2-D MULTI-GP D	264
L FUEL ELEMENT BAPL	6600	F4	RS T=	CYGR2, STRESS ANALYSIS CY	R266
4,500PSIA 32-472CECF BAPL	2000	F4	RS =	WATER, STEAM TABLES 14.5-1	R267

4 WITH DEPLETION	LASL	7030	F4	RS P T=	DTF-EURN, 1-D MULTI-GP DTF	269
GP DIFFUSION + LIB	AI	360	F4	RSBPLT=	CAESAR4/LIBLST, 1-D MULTI-	270
ARY UTILITY ROUTINE	AI	360	F4	RSB LT=	CLIP, FORM OR THREDES LIBR	271
TEMPERATURE STUDY	BAPL	2000	F4	RS P =	FIGRC, LSBR FUEL SWELLING	R272
ION DESIGN SYSTEM	AI	360	F4	RSBP T=	THREDES, 1-D FEW-GP DIFFUS	273
DIFFUSION 3-GEOM	BAPL	6600	F4	RS P T=	WIGL2, 1-D 2-GP SPACE-TIME	R274
ION CALCULATION	GEC	625	F4	RS P =	AVOID, ANNULAR VOID X-SECT	276
T ANALYSIS SYSTEM ENL-SRL	360	F4	RS PLT=	HAMMER, CRITICAL EXPERIMEN	277	
OWN ANALYSIS LOFT	UG	360	F4	RS P =	WATER-HAMMER, LIQUID BLOWD	278
FUSION SLAB CYLINDER	CDC	1604	F63	RS P T=	ZOGRAND, 2-D FEW-GROUP DIF	40
ION SLAB GEOMETRY	CDC	1604	F63	RS P =	GRACE1, GAMMA-RAY ATTENUAT	45
ION CYL SPHERE GEOM	CDC	1604	F63	RS P =	GRACE2, GAMMA-RAY ATTENUAT	46
FROM A CLOUD	CDC	1604	F63	RS P =	CLOUD, GAMMA-RAY DOSE RATE	47
SPECTRUM X-SECTIONS	CDC	1604	F63	RS PLT=	TEMPEST2, THERMAL NEUTRON	50
M X-SECTION CALC	CDC	1604	F63	RS PLT=	FORM, FAST NEUTRON SPECTRU	51
S4 APPROXIMATION	CDC	1604	F63	RS =	S4 CYL CELL CODE, 1-D 1-GP	53
FUSION DEPLETION	CDC	1604	F63	RS LT=	SIZZLE, 1-D MULTIGROUP DIF	56
USION CYLINDER SLAB	CDC	1604	F63	RS P T=	EQUIPOISE3A, 2-D 2-GP DIF	87
X-SECTION CALC	CDC	1604	F63	RS PLT=	ARES2, RESONANCE INTEGRAL	89
DRCDYNAMICS SPHERE	CDC	3600	F63	RSBP =	AXI, COUPLED NEUTRONICS-HY	102
ON SLAB CYL SPHERE	CDC	1604	F63	RS PLT=	FAIM, 1-D MULTI-GP DIFFUSI	120
CHAIN EQUATIONS	DRNL	1604	F63	RSBP =	NUCY, SOLUTION OF NUCLEIDE	134
FUNCTION SYNTHESIS	ANL	3600	F63	RSBP T=	TRAFICORPORATION, TRANSFER	135
TE ORDINATE CALC	UNC	1604	F63	RS PLT=	DTF, 1-D MULTIGROUP DISCRE	144
RE CALC CYLINDER	ANL	3600	F63	RSBP T=	ARGUS, TRANSIENT TEMPERATU	152
SN APPROXIMATION RZ	PW	1604	F63	RS P T=	FORTTRAN TDC, 2-D MULTI-GP	161
POWER DISTRIBUTION	CDC	3600	F63	RSBP T=	FLARE, 3-D REACTIVITY AND	167
VERSE KINETICS CALC	ANL	3600	F63	RSBP =	R102, SPACE-INDEPENDENT IN	168
X-SECTION CALC	ANL	3600	F63	RSBP =	NEARPEX, COMPOUND NUCLEUS	171
IREMENT STUDY	ANL	3600	F63	RS P T=	R153, PARAMETRIC SITE REQU	172
ORDINATE CODE UNC-LASL	1604	F63	RS =	2DF, 2-D MULTI-GP DISCRETE	173	
NELASTIC SCATTERING	CDC	1604	F63	RS P =	HAFFER, HAUSER-FESHBACH I	14
SLAB CYLINDER SPHERE	CDC	1604	F63	RS P T=	FOG, 1-D FEW-GP DIFFUSION	28
ON SLAB CYL SPHERE	CDC	1604	F63	RS PLT=	AIM6, 1-D MULTI-GP DIFFUSI	29
AIM AND FOG CODES	CDC	1604	F63	RS =	PERT, 1-D PERTURBATION FOR	30
FUSION XYZ GEOMETRY	CDC	1604	F63	RS P T=	WHIRLAWAY, 3-D 2-GROUP DIF	32
M X-SECTION CALC	CDC	1604	F63	RS PLT=	GAM1, FAST NEUTRON SPECTRU	33
CM REACTION OR DECAY	DRNL	1604	F63	RS P =	ISOTOPES, MAXIMUM YIELD FR	179
CHAIN ANALYSIS	DRNL	1604	F63	RS P =	ISOCRUNCH, REACTION DECAY	180
UTILITY ROUTINE	ANL	3600	F63	RSBP T=	XLIBIT, X-SECTION LIBRARY	181
TRUM X-SECTION CALC	ANL	3600	F63	RS P T=	THERMOS(ANL), THERMAL SPEC	184
LLER DESIGN STUDY	PW	1604	F63	RS P T=	PIP, CENTRIFUGAL PUMP IPFE	187
EVALUATION	PW	1604	F63	RS P =	CMPXMAT, TRANSFER FUNCTION	188
STANTS FOR DSM TDC	PW	1604	F63	RS P =	SNC, CALCULATION OF SN CEN	189
PTIMIZATION STUDY	PW	1604	F63	RS =	MOPEXPT, REACTOR WEIGHT C	190
-HYDRODYNAMICS SPH	PW	1604	F63	RS P =	AX-TAT, COUPLED NEUTRONICS	191
YNTHESIS PROGRAM CYL	PW	1604	F63	RS T=	2DXYL, 3-D MULTI-GP FLUX S	192
Y TAPE PREPARATION	PW	1604	F63	RS =	CSP2A, SN X-SECTION LIBRAR	193
TAPE PREPARATION	PW	1604	F63	RS =	CSP1, SN X-SECTION LIBRARY	194
DR 2DXY FLUX INPUT	PW	1604	F63	RS =	TDP, 2-D PERTURBATION TDC	199
RAL CALC 2-REG CELL	ANL	3600	F63	RSBP T=	R1FF-RAFF, RESONANCE INTEG	213
RAL CALC HOMOGENEOUS	ANL	3600	F63	RSBP =	MISH-MASH, RESONANCE INTEG	214
G DATA REDUCTION	ANL	3600	F63	RSBP =	COINC, COINCIDENCE COUNTIN	248
AL MODEL X-SECTIONS	ANL	3600	F63	RSBP T=	2PLUS, NON-SPHERICAL OPTIC	254
NETICS KEX OPTIONS	ANL	3600	F63	RSBP =	R101, SPACE-INDEPENDENT KI	255
ION SLAB CYL SPHERE	ANL	3600	F63	RS P T=	MACH1, 1-D MULTI-GP DIFFUS	262
FFUSION DEPLETION	BAPL	6600	F+ASC	RS T=	PDQ7, 1,2 CR 3-D FEW-GP DI	R275
INSTRUCTION SET	PW	1604	F+CDP	RS P T=	LAG, ASSEMBLER FOR FLOCC2	186
AMMA-RAY HISTORIES	PW	1604	F+CDP	RS P T=	FMC-A/FMC-G, MC NEUTRON, G	195
ANCE INTEGRAL CALC	GA	7090	F+FAP	RSB T=	ZUT, RESOLVED REGION RESON	41
GNANCE INTEGRAL CALC	GA	7090	F+FAP	RSB T=	TUZ, UNRESOLVED REGION RES	42

SPECTRUM X-SECTIONS	AI	7090	F+FAP	RS	PLT=	TENPEST2, THERMAL NEUTRON	50
BURNUP RZ GEOMETRY	GA	7090	F+FAP	RSBP	T=	DOB, 2-D FEW-GP DIFFUSION	99
DIFFUSION PROGRAM	UK-R	7090	F+FAP	RSBPLT=		GRAM, 1-D AND 2-D MULTI-GP	103
XIMUM MOMENT CALC	AI	7090	F+FAP	RS	T=	4RESTRAINT, PIPE STRESS, MA	109
ION SLAB CYL SPHERE	AI	7090	F+FAP	RS	LT=	ULCER, 1-D MULTI-GP DIFFUS	118
PECTRUM X-SECTIONS	AI	7090	F+FAP	RS	LT=	QUICKIE, INFINITE MEDIUM S	119
ON SLAB CYL SPHERE	AI	7090	F+FAP	RS	LT=	FAIM, 1-D MULTI-GP DIFFUSI	120
STIC SCAT RESONANCES	AI	7090	F+FAP	RS	PLT=	AJLME, X-SECTION CALC ELA	147
G-DOWN DENSITY CALC	AI	7094	F+FAP	RS	PLT=	TYCHE3, MONTE CARLO SLOWIN	149
DIFFUSION PROGRAM	ORNL	7090	F+FAP	RS	P T=	EXTERMINATOR, 2-D MULTI-GP	156
TILITY PROGRAM	AI	7094	F+FAP	RS	LT=	MONUS, X-SECTION LIBRARY U	159
NSFER COEFFICIENTS	LRLL	7090	F+FAP	RS	P T=	SOPHIST1/2/5, MULTI-GP TRA	160
ECTIONS PARAMETERS	AI	7094	F+FAP	RS	PLT=	GRAVE, GROUP-AVERAGING X-S	162
EQUIREMENT STUDY	AI	7094	F+FAP	RS	P T=	AISITE2, PARAMETRIC SITE R	172
ON SLAB CYL SPHERE	AI	7090	F+FAP	RS	PLT=	AJM6, 1-D MULTI-GP DIFFUSI	29
CALC 0 TO 10 MEV	BNWL	7090	F+FAP	RS	PLT=	GAMTEC2, MULTI-GP CONSTANT	185
THERMAL+INTERNAL DOSE	AI	7094	F+FAP	RS	PLT=	CURIE/DOSE/THUNDERHEAD, EX	196
-SECTION CALCULATION	GEV	7094	F+FAP	RS	P T=	EPITHERMOS, SPECTRUM AND X	201
LT1-GP DIFFUSION	WAL	7090	F+FAP	RS	P T=	VARI-QUIR, TIME-DEP 2-D MU	212
UTINES ENDF TAPES	BNL	7090	F+FAP	RS	P T=	DFSR, DATA FILE SERVICE RO	236
USION DEPLETION CODE	ORNL	7090	F+FAP	RS	P T=	ASSALTI, 2-D MULTI-GP DIFF	240
ON WITH DEPLETION	WAPC	7090	F+FAP	RSBP	LT=	LEOPARD, SPECTRA CALCULATI	279
INETICS W/FEEDBACK	AI	7094	F+MAP	RS	P T=	AIROS, SPACE-INDEPENDENT K	163
OWN ANALYSIS LOFT	KE	7094	F+MAP	RSBP	T=	SATURATED BLOWDOWN1, BLOWD	200
SRS X-SECTION TAPE	GA	7044	F+MAP	RSBP	=	UNPACK, RETRIEVAL FROM SCI	206
X-SECTION CALC	AI	7094	F+MAP	RS	PLT=	TRIX1, RESONANCE INTEGRAL	208
OR ANGULAR DIST DATA	AI	7094	F+MAP	RS	P =	CHAD, LEGENDRE COEF CALC F	215
ND LATTICE EFFECTS	GA	7044	F+MAP	RS	P T=	GARDL, RESONANCE OVERLAP A	219
USION XY RZ GEOMETRY	GA	7044	F+MAP	RSBP	T=	GAMBLE4, 2-D MULTI-GP DIFF	222
NCE AND PRICE STUDY	GA	7044	F+MAP	RS	P T=	OPUS, POWER PLANT PERFORMA	226
BURNUP CYL LATTICE	WAPC	7094	F+MAP	RS	PLT=	LASER, SPECTRUM CALC WITH	249
PHERE BDEC 360 F4	RS	P T=	FAIMOS, 1-D MULTI-GP DIFFUSION SLAB CYL S				120
ERE AI 7090 F+FAP RS	LT=		FAIM, 1-D MULTI-GP DIFFUSION SLAB CYL SPH				120
ERE CDC 1604 F63	RS	PLT=	FAIM, 1-D MULTI-GP DIFFUSION SLAB CYL SPH				120
CTION, LUMPED MASS	LASL	7094	FAP	RS	P T=	RATH, 2- OR 3-D HEAT CONDU	242
GE AI 7090 F2	RS	=	FARSEIA, DOSE RATE FROM SNAP SHIELD LEAKA				91
A GA 7044 F4	RS	P =	FASDOP, X-SECTIONS FROM B-W RESONANCE DAT				216
GA 7090 F2	RS	PLT=	GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC				33
CDC 1604 F63	RS	PLT=	GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC				33
AI 7090 F2	RS	PLT=	FORM, FAST NEUTRON SPECTRUM X-SECTION CALC				51
CDC 1604 F63	RS	PLT=	FORM, FAST NEUTRON SPECTRUM X-SECTION CALC				51
GESJ 2000 F4	RS	P T=	FORE, FAST REACTOR EXCURSION CALCULATIONS				174
ESJ 635 F4	RS	P T=	FORE2, FAST REACTOR EXCURSION CALCULATIONS				174
7090 F2	RSBPLT=	AGN-GAM,	FAST SPECTRUM MULTI-GP CONSTANT CALC			AGN	204
GRAM GA 7090 F2	RSB	T=	FEVER, 1-D FEW-GP DIFFUSION DEPLETION PRG				117
709 F2	RS	=	FIRN, 2-D FEW-GP S4 APPROXIMATION RZ GEOMETRY			LRLL	7
7090 F2	RS	P T=	FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE			AI	28
1604 F63	RS	P T=	FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE			CDC	28
7090 F2	RS	P =	MIST, 1-D FEW-GP SN DOUBLE SN APPROX SLAB GEOM PP				59
7090 F+FAP RSBP T=	DOB,	2-D	FEW-GP DIFFUSION BURNUP RZ GEOMETRY			GA	99
7090 F2	RSB	T=	FEVER, 1-D FEW-GP DIFFUSION DEPLETION PROGRAM			GA	117
7040 F4	RS	P T=	TOPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER			PP	148
7090 F2	RS	P T=	TOPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER			PP	148
7044 F4	RS	P T=	GASP2, 1-D FEW-GP DIFFUSION POWER DIST SEARCH			GA	220
RS P T=	RELQAD-FEVER,	1-D	FEW-GP DIFFUSION DEPLETION			GA 7044 F4	221
7044 F4	RS	P T=	TEMCO, 1-D FEW-GP DIFFUSION TEMP COEF CALC			GA	225
60 F4	RSBP	T=	THREDES, 1-D FEW-GP DIFFUSION DESIGN SYSTEM			AI 3	273
+ASC RS	T=	PD07, 1,2 OR	3-D FEW-GP DIFFUSION DEPLETION			BAPL 6600 F	R275
90 F2	RS	P T=	ZOGRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER			ORNL 70	40
04 F63	RS	P T=	ZOGRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER			CDC 16	40
DY	BAPL 2000 F4	RS	P =	FIGRO, LSBR FUEL SWELLING TEMPERATURE		STU	R272

7090 F+FAP RS P T=	CFSR, DATA	FILE SERVICE ROUTINES ENDF TAPES	BNL	236
SCARF2, SCATTER FROM RADIATOR	FINS SNAP GEOM	AI	7090 F2 RS	= 110
HERE ROA 360 F4 RS PLT=	FIRE2, 1-D AGE-DIFFUSION SLAB CYLINDER SP			9
ETRY LRL 709 F2 RS	= FIRN, 2-D FEW-GP S4 APPROXIMATION RZ GEOM			7
7044 F4 RS P =	RAD2, HTGR FISSION PRODUCT ACTIVITY DIST STUDY GA			231
L LEAST SQUARES, GENERAL CURVE	FITTING LASL 7094 F4 RS	= LAS		62
TION GA 7044 F4 RS	= FLANGE1, SCATTERING LAW X-SECTION CALCULA			247
ION GESJ 2000 F+TAC RS T=	FLARE, 3-D REACTIVITY AND POWER DISTRIBUT			167
ION GESJ 635 F4 RS P T=	FLARE, 3-D REACTIVITY AND POWER DISTRIBUT			167
ION CDC 3600 F63 RSBP T=	FLARE, 3-D REACTIVITY AND POWER DISTRIBUT			167
DOUBLE SN APPROX	BNWL 7090 FLOCD RSBP T=	GE-HAPD-S13, 1-D MULTI-GP		75
ULTI-GP X-SECTIONS	LASL 7090 FLOCD RS P =	ZOT, GROUP-COLLAPSING OF M		113
OXIMATION XY GEOM	AGN 7090 FLOCD RSBP =	2DXY, 2-D MULTI-GP SN APPR		18
ENETRATION STUDY	LASL 7090 FLOCD RS P =	MCS, MONTE CARLO NEUTRON P		202
OP RS P T=	LAG, ASSEMBLER FOR FLOCD2 INSTRUCTION SET	PW 1604 F+C		186
DEL, MULTI-CHANNEL 2-D 2-PHASE	FLOW AI 7094 F2 RS P =	FLOW-MO		246
P T=	TRANS-FUGUE1, TRANSIENT FLOW AND HEAT TRANSFER AI	7094 F2 RS		266
RS P =	CROC90, ML-1 FLUID FLOW EXPERIMENT ANALYSIS	AGN 7090 F2		154
W AI 7094 F2 RS P =	FLOW-MODEL, MULTI-CHANNEL 2-D 2-PHASE FLO			246
90 F2 RS P =	CROC90, ML-1 FLUID FLOW EXPERIMENT ANALYSIS	AGN 70		154
N 7090 F2 RS P =	BOUNCE, FLUX DIST IN MULTI-PIN FUEL ELEMENT	AG		237
, 2-D PERTURBATION TDC OR 2DXY	FLUX INPUT PW 1604 F63 RS	= TDP		199
RS T=	2DXYL, 3-D MULTI-GP FLUX SYNTHESIS PROGRAM CYL PW	1604 F63		192
PARAMETERS HETEROGENEOUS CALC	FMA 7090 F2 RSBP =	PERESY1, LATTICE		196
IES PW 1604 F+COP RS P T=	FMC-N/FMC-G, MC NEUTRON, GAMMA-RAY HISTOR			195
, 1-D PERTURBATION FOR AIM AND	FOG CODES AI 7090 F2 RS	= PERT		30
, 1-D PERTURBATION FOR AIM AND	FOG CODES CDC 1604 F63 RS	= PERT		30
, 1-D PERTURBATION FOR AIM AND	FOG CODES BOEC 360 F4 RS P	= PERT		30
PHERE AI 7090 F2 RS P T=	FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER S			28
PHERE CDC 1604 F63 RS P T=	FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER S			28
S GESJ 635 F4 RS P T=	FORE2, FAST REACTOR EXCURSION CALCULATION			174
GESJ 2000 F4 RS P T=	FORE, FAST REACTOR EXCURSION CALCULATIONS			174
AI 360 F4 RSB LT=	CLIP, FORM OR THREEDES LIBRARY UTILITY ROUTINE			271
C AI 7090 F2 RS PLT=	FORM, FAST NEUTRON SPECTRUM X-SECTION CAL			51
C CDC 1604 F63 RS PLT=	FORM, FAST NEUTRON SPECTRUM X-SECTION CAL			51
N R2 PW 1604 F63 RS P T=	FORTAN TDC, 2-D MULTI-GP SN APPROXIMATIO			161
Z RS P =	ATMFIRE, URANIUM FUEL CYCLE COST ANALYSIS	AI 7090 F		55
7090 F2 RSBP =	NPRFCOP, FUEL CYCLE COSTS PERFORMANCE DATA	KE		146
44 F4 RS P T=	REVISED-GAD, FUEL CYCLE ANALYSIS W/REFUELING	GA 70		223
7044 F4 RS P =	WAMPUM, FUEL CYCLE COSTS PERFORMANCE STUDY	GA		224
7044 F4 RS P T=	GARGOYLE, FUEL CYCLE ANALYSIS PARTIAL REFUEL	GA		260
A 7044 F4 RS P T=	ELBOW, FUEL ELEMENT STRESS ANALYSIS STDY	G		229
BOUNCE, FLUX DIST IN MULTI-PIN	FUEL ELEMENT AGN 7090 F2 RS P =			237
= CYGRO2, STRESS ANALYSIS CYL	FUEL ELEMENT BAPL 6600 F4 RS T			R266
000 F4 RS P =	FIGRO, LSBR FUEL SWELLING TEMPERATURE STUDY	BAPL 2		R272
= CORE, CORE CONFIGURATION	FUEL TEMPERATURE CODE GA 7044 F4 RS			233
= AXFLU, HEAT TRANSFER POLTEN	FUEL TUBE BUNDLES LASL 7094 F2 RS P			182
= AXTHRM, HEAT TRANSFER SOLID	FUEL TUBE BUNDLES LASL 7094 F2 RS P			182
TION AI 7090 F2 RS	= FUGUE, STEADY-STATE TEMPERATURE VOID FRAC			48
JR, MODERATOR SPACE CHORD DIST	FUNCT AEG 7090 F2 RS	= DANCOFF		150
T=	TRAFICORPORATION, TRANSFER FUNCTION SYNTHESIS	ANL 3600 F63 RSBP		135
3 RS P =	CHPMAT, TRANSFER FUNCTION EVALUATION	PW 1604 F6		188
E STRESS ANALYSIS, 2-D BODIES	GA 1108 F4 RS P =	SAFE-PLANE, PLAN		252
SS ANALYSIS THIN SHELLS	GA 1108 F4 RS P =	SAFE-SHELL, STRE		253
TOR SHIELDING CODE CAVITY GEOM	GA 1108 F4 RS P T=	MUSCAT, VIEW FAC		259
GR ACCIDENT ANALYSIS DOSE CALC	GA 1108 F4 RS T=	GADOSE/DOSET, HT		261
SCATTERING LAW CALCULATION	GA 1108 F4 RS P =	GASKET, THERMAL		263
ON SPECTRUM X-SECTION CALC	GA 7090 F2 RS PLT=	GAM1, FAST NEUTR		.33
GION RESONANCE INTEGRAL CALC	GA 7090 F+FAP RSB T=	ZUT, RESOLVED RE		41
REGION RESONANCE INTEGRAL CALC	GA 7090 F+FAP RSB T=	TUZ, UNRESOLVED		42
INE SCATTERING KERNEL CALC	GA 7090 F2 RS T=	SUPMIT, CRYSTALL		56

DIFFUSION BURNUP RZ GEOMETRY	GA	7090	F+FAP	RSBP	T=	GDB, 2-D FEW-GP	99
P DIFFUSION DEPLETION PROGRAM	GA	7090	F2	RSB	T=	FEVER, 1-D FEW-G	117
INETICS WITH 2-D HEAT TRANSFER	GA	7044	F4	RS	T=	BLCCOSTS, POINT-K	205
L FROM SCISRS X-SECTION TAPE	GA	7044	F+MAP	RSBP	=	UNPACK, RETRIEVA	206
O PLOTS FROM X-SECTION TAPES	GA	7044	F4	RSBP	T=	CROSSPLOT, SC402	207
NS FROM B-W RESONANCE DATA	GA	7044	F4	RS	P =	FASOGP, X-SECTION	216
RE CCEF CALC FOR ANGULAR DIST	GA	7044	F4	RS	P =	LEGCECF3, LEGEND	217
TERVAL X-SECTION AVERAGING	GA	7044	F4	RS	P =	GAYER, ENERGY IN	218
OVERLAP AND LATTICE EFFECTS	GA	7044	F+MAP	RS	P T=	GAROL, RESONANCE	219
P DIFFUSION POWER DIST SEARCH	GA	7044	F4	RS	P T=	GASP2, 1-D FEW-G	220
D FEW-GP DIFFUSION DEPLETION	GA	7044	F4	RS	P T=	RELOAD-FEVER, 1-	221
TI-GP DIFFUSION XY RZ GEOMETRY	GA	7044	F+MAP	RSBP	T=	GAMBLE4, 2-D MUL	222
L CYCLE ANALYSIS W/REFUELING	GA	7044	F4	RS	P T=	REVISED-GAD, FUE	223
LE COSTS PERFORMANCE STUDY	GA	7044	F4	RS	P =	WAMPUM, FUEL CYC	224
P DIFFUSION TEMP CCEF CALC	GA	7044	F4	RS	P T=	TEMCC, 1-D FEW-G	225
T PERFORMANCE AND PRICE STUDY	GA	7044	F+MAP	RS	P T=	GPUS, POWER PLAN	226
NERATOR DESIGN CRITERIA COSTS	GA	7044	F4	RS	P T=	STMGEN, STEAM GE	227
TAINTMENT PRESSURE POST RUPTURE	GA	7044	F4	RS	T=	PRECCN, PTGR CCN	228
ENT STRESS ANALYSIS STUDY	GA	7044	F4	RS	P T=	ELBOW, FUEL ELEM	229
ESS ANALYSIS OF 2-D BODIES	GA	7044	F4	RS	P T=	PIZZA, PLANE STR	230
ON PRODUCT ACTIVITY DIST STUDY	GA	7044	F4	RS	P =	RAD2, HTGR FISSI	231
OLED CORE THERMAL DESIGN STUDY	GA	7044	F4	RS	P =	GAZELLE5, GAS-CC	232
GURATION FUEL TEMPERATURE CODE	GA	7044	F4	RS	=	CORE, CORE CNFI	233
ING LAW X-SECTION CALCULATION	GA	7044	F4	RS	=	FLANGE1, SCATTER	247
S ANALYSIS AXISYMMETRIC LOAD	GA	7044	F4	RS	P T=	SAFE-PCRS, STRES	250
ESS ANALYSIS AXISYMMETRIC LOAD	GA	7044	F4	RS	P T=	SAFE-AXISYM, STR	251
YCLE ANALYSIS PARTIAL REFUEL	GA	7044	F4	RS	P T=	GARGCYL, FUEL C	260
CALC GA 1108 F4 RS T=						GADOSE/COSET, HTGR ACCIDENT ANALYSIS COSE	261
C GA 7090 F2 RS PLT=						GAM1, FAST NEUTRON SPECTRUM X-SECTION CAL	32
C CDC 1604 F63 RS PLT=						GAM1, FAST NEUTRON SPECTRUM X-SECTION CAL	32
METRY GA 7044 F+MAP RSEP T=						GAMBLE4, 2-D MULTI-GP DIFFUSION XY RZ GEC	222
WAYS GEC 7094 F4 RS P =						GAMMA-P, PRODUCTION X-SECTIONS FOR GAMMA-	235
7090 F2 RS P = GRACE1,						GAMMA-RAY ATTENUATION SLAB GEOMETRY AI	45
C 1604 F63 RS P = GRACE1,						GAMMA-RAY ATTENUATION SLAB GEOMETRY CD	45
7090 F2 RS P = GRACE2,						GAMMA-RAY ATTENUATION CYL SPHERE GECM AI	46
C 1604 F63 RS P = GRACE2,						GAMMA-RAY ATTENUATION CYL SPHERE GECM CD	46
I 7090 F2 RS P = CLCUD,						GAMMA-RAY DOSE RATE FROM A CLCUD A	47
DC 1604 F63 RS P = CLCUD,						GAMMA-RAY DOSE RATE FROM A CLCUD C	47
RL 360 F4 RS P = CLOCU,						GAMMA-RAY DOSE RATE FROM A CLOCUD S	47
M 7090 MAD RSB = BURP4,						GAMMA-RAY PHOTOFRACITION SOLID CRYSTAL U	169
M 7090 MAD RSB = BURP5,						GAMMA-RAY PHOTOFRACITION WELL CRYSTAL U	170
P T= FMC-N/FMC-G, MC NEUTRON,						GAMMA-RAY HISTORIES PW 1604 F+CDP RS	195
A-P, PRODUCTION X-SECTIONS FOR						GAMMA-RAYS GEC 7094 F4 RS P = GAMM	235
EV BNWL 7090 F+FAF RS PLT=						GAMTEC2, MULTI-GP CONSTANT CALC Q TO IO M	185
EV BNWL 1107 F4 RS PLT=						GAMTEC2, MULTI-GP CONSTANT CALC Q TO IO P	185
UEL GA 7044 F4 RS P T=						GARGOYLE, FUEL CYCLE ANALYSIS PARTIAL REF	260
CTS GA 7044 F+MAP RS P T=						GARCL, RESONANCE OVERLAP AND LATTICE EFFE	219
7044 F4 RS P = GAZELLE5,						GAS-COOLED CORE THERMAL DESIGN STUDY GA	232
N GA 1108 F4 RS P =						GASKET, THERMAL SCATTERING LAW CALCULATIO	263
ARCH GA 7044 F4 RS P T=						GASP2, 1-D FEW-GP DIFFUSION POWER DIST SE	220
G GA 7044 F4 RS P =						GAYER, ENERGY INTERVAL X-SECTION AVERAGIN	218
STUDY GA 7044 F4 RS P =						GAZELLE5, GAS-COOLED CORE THERMAL DESIGN	232
OID X-SECTION CALCULATION						GEC 625 F4 RS P = AVCID, ANNULAR V	276
IGN X-SECTIONS FOR GAMMA-RAYS						GEC 7094 F4 RS P = GAMMA-P, PRODUCT	235
X BNWL 7090 FLECC RSBP T=						GE-HAPO-S13, 1-D MULTI-GP DOUBLE SN APPRO	75
4 F4 RS P T= STMGEN, STEAM						GENERATOR DESIGN CRITERIA COSTS GA 704	227
D MULTI-GP SN APPROXIMATION XY						GEOM AGN 7090 FLECC RSBP = 2CXY, 2-	18
CATTER FROM RADIATOR FINS SNAP						GEOM AI 7090 F2 RS = SCARF2, S	110
MMA-RAY ATTENUATION CYL SPHERE						GEOM AI 7090 F2 RS P = GRACE2, GA	46
MMA-RAY ATTENUATION CYL SPHERE						GEOM CDC 1604 F63 RS P = GRACE2, GA	46
W FACTOR SHIELDING CODE CAVITY						GEOM GA 1108 F4 RS P T= MUSCAT, VIE	259

EW-GP SN DOUBLE SN APPROX SLAB	GEOM PP	7090 F2	RS P = MIST, 1-C F	55
E1, GAMMA-RAY ATTENUATION SLAB	GEOMETRY	A1 7090 F2	RS P = GRAC	45
E1, GAMMA-RAY ATTENUATION SLAB	GEOMETRY	CDC 1604 F63	RS P = GRAC	45
1-C 1-GP SN APPROXIMATION SLAB	GEOMETRY	A1 7090 F2	RS = SAIL,	52
2-C FEK-GP DIFFUSION BURNUP RZ	GEOMETRY	GA 7090 F+FAP	RSEP T= DCB,	55
CAR1, SCATTER FROM A RING SNAP	GEOMETRY	A1 7090 F2	RS = S	111
INS, SA, 1-REGION KINETICS SNAP	GEOMETRY	A1 7090 F2	RS = SNAPK	122
AP, DOSE RATE CALCULATION SNAP	GEOMETRY	A1 7090 F2	RS P = PAIR	141
ER, DOSE RATE CALCULATION SNAP	GEOMETRY	A1 7090 F2	RS = MORTIM	142
SHIELD DESIGN MULTIGROUP SLAB	GEOMETRY	BNWL 7090 F2	RSEPLY= MAC,	142
2-C FEK-GP S4 APPROXIMATION RZ	GEOMETRY	LRLL 709 F2	RS = FIRM,	7
WAY, 3-D 2-GROUP DIFFUSION XYZ	GEOMETRY	ORNL 7090 F2	RS P T= WHIRLA	32
WAY, 3-D 2-GROUP DIFFUSION XYZ	GEOMETRY	CDC 1604 F63	RS P T= WHIRLA	32
, 2-D MULTI-GP DIFFUSION XY RZ	GEOMETRY	GA 7044 F+FAP	RSEP T= GAMELE4	222
IVITY AND POWER DISTRIBUTION	GESJ	625 F4	RS P T= FLARE, 3-D REACT	167
TOR EXCURSION CALCULATIONS	GESJ	625 F4	RS F T= FORE2, FAST REAC	174
ATE THERMAL-HYDRAULIC ANALYSIS	GESJ	625 F4	RS F T= MANTA, STEADY-ST	256
ESONANCE EPITHERMAL X-SECTIONS	GESJ	625 F4	RS F T= REAX, RESOLVED R	257
F PULSED NEUTRON SOURCE DATA	GESJ	625 F4	RS F T= EXPN, ANALYSIS C	258
OR EXCURSION CALCULATIONS	GESJ	2000 F4	RS F T= FORE, FAST REACT	174
CE INTEGRAL X-SECTION CALC	GESJ	2000 F2	RS P = RAFTLE, RESCAN	176
RESONANCE X-SECTION CALC	GESJ	2000 F2	RS P = UCPLE, RESOLVED	177
Y-AVERAGED DOPPLER EFFECTS	GESJ	2000 F2	RS P = SPARTA, SPATIAL	178
TRUP AND X-SECTION CALCULATION	GEV	7094 F+FAP	RS P T= EPITHERMGS, SPEC	201
RY A1 7090 F2 RS P =	GRACE1, GAMMA-RAY ATTENUATION SLAB	GEOMET		45
RY CDC 1604 F63 RS P =	GRACE1, GAMMA-RAY ATTENUATION SLAB	GEOMET		45
GEGP A1 7090 F2 RS P =	GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE			46
GEGP CDC 1604 F63 RS P =	GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE			46
ERS A1 7094 F+FAP RS PLT=	GRAVE, GROUP-AVERAGING X-SECTIONS	PARAMET		162
I 7094 F+FAP RS FLT= GRAVE,	GROUP-AVERAGING X-SECTIONS	PARAMETERS	A	162
LASL 7090 FLOCC RS P = ZOT,	GROUP-CELLAPSING OF MULTI-GP X-SECTIONS			112
RING CDC 1604 F63 RS P =	HAFFEVER, HAUSER-FESHBACH INELASTIC SCATTE			14
EM BNWL-SRL 7090 F2 RS PLT=	HAMMER, CRITICAL EXPERIMENT ANALYSIS SYST			277
EM BNWL-SRL 360 F4 RS PLT=	HAMMER, CRITICAL EXPERIMENT ANALYSIS SYST			277
CDC AGN 7090 F2 RSE =	HATCHET, COUPLED NEUTRONICS-HYDRODYNAMICS			152
1604 F63 RS P = HAFFEVER,	HAUSER-FESHBACH INELASTIC SCATTERING CDC			14
FAP RS P T= RATH, 2- CR 3-C	HEAT CONDUCTION LUMPED MASS	LASL 7094		242
ASL 7094 F2 RS P = AXFLU,	HEAT TRANSFER MOLTEN FUEL TUBE BUNDLES	L		182
SL 7094 F2 RS P = AXTRM,	HEAT TRANSFER SOLID FUEL TUBE BUNDLES	LA		183
ATING2, TRANSIENT STEADY-STATE	HEAT TRANSFER A1 7094 F2	RS P T= PE		192
CGST5, POINT-KINETICS WITH 2-C	HEAT TRANSFER GA 7044 F4	RS T= BL		205
ANS-FUGUE1, TRANSIENT FLOW AND	HEAT TRANSFER A1 7094 F2	RS P T= TR		268
NSFER A1 7094 F2 RS P T=	HEATING2, TRANSIENT STEADY-STATE HEAT TRA			195
CALC FMA 7090 F2 RSEP =	MERESY1, LATTICE PARAMETERS HETEROGENEOUS			136
= MERESY1, LATTICE PARAMETERS	HETEROGENEOUS CALC FMA 7090 F2	RSEP		136
RE BNWL 1107 F4 RS P T=	HFN, 1-C MULTI-GP DIFFUSION SLAB CYL SPHE			241
N/FYC-G, MC NEUTRON, GAMMA-RAY	HISTORIES Ph 1604 F+CDP	RS P T= FNC-		195
BLOWDOWN PRESSURE TEMPERATURE	HISTORY KE 7094 F2	RSEP T= PTH1,		155
-MASH, RESONANCE INTEGRAL CALC	HOMOGENEOUS ANL 3600 F63	RSEP = MISH		214
8 F4 RS T= GADCE/COSET,	HTGR ACCIDENT ANALYSIS DOSE CALC GA	110		261
7044 F4 RS T= PRECON,	HTGR CONTAINMENT PRESSURE PCST RUPTURE GA			228
GA 7044 F4 RS P = RAD2,	HTGR FISSION PRODUCT ACTIVITY DIST STUDY			231
RS P T= PIP, CENTRIFUGAL PUMP	IMPELLER DESIGN STUDY Ph 1604 F63			187
P = HAFFEVER, HAUSER-FESHBACH	INELASTIC SCATTERING CDC 1604 F63	RS		14
7090 F+FAP RS LT= QUICKIE,	INFINITE MEDIUM SPECTRUM X-SECTIONS	A1		115
4 F4 RS P = GAVER, ENERGY	INTERVAL X-SECTION AVERAGING	GA 704		218
BP = R102, SPACE-INDEPENDENT	INVERSE KINETICS CALC ANL 3600 F63	RS		168
= R102, SPACE-INDEPENDENT	INVERSE KINETICS CALC WAL 7094 F4	RS		168
CRNL 7090 F2 RS P =	ISOCRUNCH, REACTION DECAY CHAIN ANALYSIS			180
CRNL 1604 F63 RS P =	ISOCRUNCH, REACTION DECAY CHAIN ANALYSIS			180
DECAY ORNL 1604 F63 RS P =	ISOTOFES, MAXIMUM YIELD FROM REACTION CR			175

CLIC BLOWDOWN ANALYSIS LOFT	KE	3600 F2	RSBP = WATER-HAMMER, LI	278	
CLE COSTS PERFORMANCE DATA	KE	7090 F2	RSBP = APRFCCP, FUEL CY	146	
RESSURE TEMPERATURE HISTORY	KE	7094 F2	RSBP T= PTH-1, BLOWDOWN P	155	
WNI, BLOWDOWN ANALYSIS LOFT	KE	7094 F+MAP	RSBP T= SATURATED BLOWDO	200	
SUMMIT, CRYSTALLINE SCATTERING	KERNEL CALC	GA	7090 F2 RS T=	56	
01, SPACE-INDEPENDENT KINETICS	KEX OPTIONS	ANL	3600 F63 RSBP = R1	255	
01, SPACE-INDEPENDENT KINETICS	KEX OPTIONS	WAL	7094 F4 RS P = R1	255	
= AIREK3, SPACE-INDEPENDENT	KINETICS W/FEEDBACK	AI	7090 F2 RS	121	
= AIREK3, SPACE-INDEPENDENT	KINETICS W/FEEDBACK	ROA	360 F4 RS P	121	
RS = SNAPKIN5, SA, 1-REGION	KINETICS SNAP GEOMETRY	AI	7090 F2	122	
P T= AIRGS, SPACE-INDEPENDENT	KINETICS W/FEEDBACK	AI	7094 F+MAP RS	163	
P T= AIRCS, SPACE-INDEPENDENT	KINETICS W/FEEDBACK	AI	360 F4 RSB	163	
102, SPACE-INDEPENDENT INVERSE	KINETICS CALC	ANL	3600 F63 RSBP = R	168	
102, SPACE-INDEPENDENT INVERSE	KINETICS CALC	WAL	7094 F4 RS = R	168	
BP = R101, SPACE-INDEPENDENT	KINETICS KEX OPTIONS	ANL	3600 F63 RS	255	
P = R101, SPACE-INDEPENDENT	KINETICS KEX OPTIONS	WAL	7094 F4 RS	255	
ALC FROM DSN OUTPUT PW 1604	LAG1 RS P =	CTX, EFFECTIVE X-SECTION C		210	
RCX SLAB CYL SPHERE PW 1604	LAG1 RS P =	MGDSN, 1-D MULTI-GP SN AFP		211	
PW 1604 F+CDP RS P T=	LAG, ASSEMBLER FOR FLOCC2	INSTRUCTION SET		186	
ICE WAPD 7094 F+MAP RS PLT=	LASER, SPECTRUM CALC WITH BURNUP CYL LATT			249	
GP DISCRETE COORDINATE PROGRAM	LASL 6600 F4	RS P T= DTF4, 1-D MULTI-		209	
ES, GENERAL CURVE FITTING	LASL 7094 F4	RS = LASL LEAST SQUARE		62	
PSING OF MULTI-GP X-SECTIONS	LASL 7090 FLOCO	RS F = LOT, GROUP-COLLA		112	
SFER MELTEN FUEL TUBE BUNDLES	LASL 7094 F2	RS F = AXFLL, HEAT TRAN		182	
NSFER SOLID FUEL TUBE BUNDLES	LASL 7094 F2	RS F = AXTHRM, HEAT TRA		182	
NEUTRON PENETRATION STUDY	LASL 7090 FLOCO	RS P = MCS, MONTE CARLO		202	
GP DISCRETE COORDINATE PROGRAM	LASL 7090 F4	RS F T= DTF4, 1-D MULTI-		209	
ATION FOR 2-D DESIGN PROGRAMS	LASL 7090 F2	RS P T= OPC, DATA PREPAR		234	
HEAT CONDUCTION LUMPED MASS	LASL 7094 FAP	RS P T= RATH, 2- CR 3-C		242	
LTI-GP DTF4 WITH DEPLETION	LASL 7090 F4	RS P T= CTF-BURN, 1-C MU		269	
LASL 7094 F4 RS =	LASL LEAST SQUARES, GENERAL CURVE FITTING			62	
7090 F2 RSBP = KENESY1,	LATTICE PARAMETERS HETEROGENEOUS CALC FPA			136	
GAROL, RESONANCE OVERLAP AND	LATTICE EFFECTS	GA	7044 F+MAP RS P T=	219	
SPECTRUM CALC WITH BURNUP CYL	LATTICE WAPD 7094 F+MAP RS PLT=	LASER,		249	
1A, DOSE RATE FROM SNAP SHIELD	LEAKAGE	AI	7090 F2 RS = FARSE	91	
LASL 7094 F4 RS = LASL	LEAST SQUARES, GENERAL CURVE FITTING			62	
DIST GA 7044 F4 RS P =	LEGCEGF3, LEGENDRE COEF CALC FOR ANGULAR			217	
AI 7094 F+MAP RS P = C+AD,	LEGENDRE COEF CALC FOR ANGULAR DIST DATA			215	
7044 F4 RS P = LEGCEGF3,	LEGENDRE COEF CALC FOR ANGULAR DIST CA			217	
ON WAPD 7090 F+MAP RSPLT=	LEOPARD, SPECTRA CALCULATION WITH DEPLETI			279	
BLST, 1-D MULTI-GP DIFFUSION +	LIB AI	360 F4 RSPLT= CAESAR4/LI		270	
+FAP RS LT= MOMUS, X-SECTION	LIBRARY UTILITY PROGRAM	AI	7094 F	159	
3 RSBP T= XLBIT, X-SECTION	LIBRARY UTILITY ROUTINE	ANL	3600 F6	181	
RS = CSP2A, SN X-SECTION	LIBRARY TAPE PREPARATION	PW	1604 F63	193	
RS = CSP1, SN X-SECTION	LIBRARY TAPE PREPARATION	PW	1604 F63	194	
RSB LT= CLTP, FROM CR THREDES	LIBRARY UTILITY ROUTINE	AI	360 F4	271	
TION DAC 7090 F2 RSBP =	LIPRECANT, MC NEUTRON PENETRATION CALCULA			123	
0 F2 RSEP = WATER-HAMMER,	LIQUID BLOWDOWN ANALYSIS LOFT	KE	360	278	
0 F4 RS P = WATER-HAMMER,	LIQUID BLOWDOWN ANALYSIS LOFT	UG	36	278	
, STRESS ANALYSIS AXISYMMETRIC	LOAD GA	7044 F4 RS P T=	SAFE-PCRS	250	
, STRESS ANALYSIS AXISYMMETRIC	LOAD GA	7044 F4 RS P T=	SAFE-AXISYM	251	
D BLOWDOWN1, BLOWDOWN ANALYSIS	LOFT	KE	7094 F+MAP RSBP T=	SATURATE	200
PPER, LIQUID BLOWDOWN ANALYSIS	LOFT	KE	3600 F2 RSBP =	WATER-HA	278
PPER, LIQUID BLOWDOWN ANALYSIS	LOFT	UG	360 F4 RS P =	WATER-HA	278
GP DISCRETE COORDINATE PROGRAM	LRC 7094 F4	RS F T= DTF4, 1-C MULTI-		209	
S4 APPROXIMATION RZ GEOMETRY	LRL 709 F2	RS = FIRN, 2-D FEW-GP		7	
EUTRONICS-HYDRODYNAMICS SPHERE	LRL 7090 F2	RS F = CCNEC, COUPLED N		129	
LTI-GP TRANSFER COEFFICIENTS	LRL 7090 F+MAP	RS F T= SOPHIST1/2/5, MU		160	
APL 2000 F4 RS P = FICRE,	LSBR FUEL SWELLING TEMPERATURE STUDY	B		R272	
ATH, 2- CR 3-C HEAT CONDUCTION	LUMPED MASS	LASL 7094 FAP	RS P T= R	242	
HERE ANL 3600 F63 RS P T=	MACH-1, 1-D MULTI-GP DIFFUSION SLAB CYL SP			262	

RY	BNWL 7090 F2	RSEPLT=	MAC, SHIELD DESIGN MULTIGROUP SLAB GEOMET	142
POINT SOURCE	UP	7090 MAD	RSB = BURP1, DETECTOR EFFICIENCY	164
DISK SOURCE	UP	7090 MAD	RSB = BURP2, DETECTOR EFFICIENCY	165
POINT SOURCE	UP	7090 MAD	RSB = BURP3, DETECTOR EFFICIENCY	166
TIGA SOLID CRYSTAL	UP	7090 MAD	RSB = BURP4, GAMMA-RAY PHOTOFRAC	169
TICK WELL CRYSTAL	UP	7090 MAD	RSB = BURP5, GAMMA-RAY PHOTOFRAC	170
LYSIS GESJ 635 F4	RS P T=	MANTA, STEADY-STATE THERMAL-HYDRAULIC ANA		256
ANALYSIS PROGRAM	PP	7040 MAP	RSBP T= RSAC, RADIOLOGICAL SAFETY	265
CR 3-D HEAT CONDUCTION LUMPED MASS	LASL 7094 FAP	RS P T=	RATH, 2-	242
7090 F2	RSBP =	LIPRECAN1, MC NEUTRON PENETRATION CALCULATION	OAC	123
04 F+CDP RS P T=	FMC-N/FMC-G,	MC NEUTRON, GAMMA-RAY HISTORIES	PW	195
Y	LASL 7090 FLOCC	RS P =	MCS, MONTE CARLO NEUTRON PENETRATION STUD	202
MULTI-GP CONSTANT CALC 0 TO 10 MEV	BNWL 7090 F+FAP	RS PLT=	GAMTEC2,	185
MULTI-GP CONSTANT CALC 0 TO 10 MEV	BNWL 1107 F4	RS PLT=	GAMTEC2,	185
HERE PW	1604 LAG1	RS P =	MGDSN, 1-D MULTI-GP SN APPROX SLAB CYL SP	211
NECUS ANL	3600 F63	RSBP =	MISH-MASH, RESONANCE INTEGRAL CALC HOMOGGE	214
GFCM PP	7090 F2	RS P =	MIST, 1-D FEW-GP SN DOUBLE SN APPROX SLAB	55
N 7090 F2	RS P =	CROC90, ML-1 FLUID FLOW EXPERIMENT ANALYSIS	AG	154
G9C F2	RS	=	DANCOFF JR, MODERATOR SPACE CHORD DIST FUNCT	AEG 7
RS P =	AXFL, HEAT TRANSFER	MOLTEN FUEL TUBE BUNDLES	LASL 7094 F2	182
RESTRAINT PIPE STRESS, MAXIMUM	MOMENT CALC	AI	7090 F+FAP RS	T= 4
AI	7094 F+FAP RS	LT=	MEMUS, X-SECTION LIBRARY UTILITY PROGRAM	159
7094 F+FAP RS PLT=	TYC+E3,	MONTE CARLO SLOWING-DOWN DENSITY CALC	AI	149
LASL 7090 FLOCC	RS P =	MCS, MONTE CARLO NEUTRON PENETRATION STUDY		202
ETRY AI	7090 F2	RS	=	MORTIMER, DOSE RATE CALCULATION SNAP GECH
090 F2	RS	LT=	SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION	AI 7
604 F63	RS	LT=	SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION	CDC 1
360 F4	RSBP T=	SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION	AI	58
RSBP LT=	MAC, SHIELD DESIGN MULTIGROUP SLAB GEOMETRY	BNWL 7090 F2		142
1604 F63	RS PLT=	DTF, 1-D MULTIGROUP DISCRETE ORDINATE CALC	UNC	144
094 F2	RS P =	FLOW+POCEL, MULTI-CHANNEL 2-D 2-PHASE FLOW	AI 7	246
SBPLT=	AGN-GAM, FAST SPECTRUM	MULTI-GP CONSTANT CALC	AGN 7090 F2	R
7030 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	LASL	209
7094 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	LRC	209
6600 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	LASL	209
625 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	BEC	209
360 F4	RS P T=	DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM	ANL	209
1604 LAG1	RS P =	MGDSN, 1-D MULTI-GP SN APPROX SLAB CYL SPHERE	PW	211
P T=	VARI-QUIR, TIME-DEP	2-D MULTI-GP DIFFUSION	WAL 7090 F+FAP RS	212
44 F+MAP	RSBP T=	CABLE4, 2-D MULTI-GP DIFFUSION XY RZ GEOMETRY	GA 70	222
90 F+FAP	RS P T=	ASSAULT, 2-D MULTI-GP DIFFUSION DEPLETION CODE	CRNL 70	240
L 1107 F4	RS P T=	PFA, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	BNW	241
RS P T=	AGN-SICMA, CALC OF	MULTI-GP TRANSFER MATRICES	ACN 7090 F2	242
3600 F63	RS P T=	PACH1, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	ANL	262
7090 FLOCC	RSBP =	2CXY, 2-D MULTI-GP SN APPROXIMATION XY GECH	AGN	18
7090 F+FAP	RS PLT=	AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	AI	29
1604 F63	RS PLT=	AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	CDC	29
LQCC	RSBP T=	GE-HAPE-S13, 1-D MULTI-GP DOUBLE SN APPROX	BNWL 7090 F	75
FAP	RSEPLT=	CRAM, 1-D AND 2-D MULTI-GP DIFFUSION PROGRAM	UK-R 7090 F+	102
P =	ZGT, GROUP-COLLAPSING	OF MULTI-GP X-SECTIONS	LASL 7090 FLOCC	RS
7090 F+FAP	RS	LT=	ULCER, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	AI
7090 F+FAP	RS	LT=	FAIP, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	AI
1604 F63	RS PLT=	FAIP, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	CDC	120
360 F4	RS P T=	FAIMDS, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE	BDEC	120
7090 F2	RS P T=	W-DSN, 1-D MULTI-GP SN APPROX SLAB CYL SPHERE	UK-W	132
7090 F2	RS PLT=	DTF2, 1-D MULTI-GP DISCRETE ORDINATE CALC	AI	151
360 F4	RSBP LT=	ANISH, 1-D MULTI-GP DISCRETE ORDINATE CALC	AI	151
FAP	RS P T=	EXTERMINATOR, 2-D MULTI-GP DIFFUSION PROGRAM	CRNL 7090 F+	156
RS P T=	EXTERMINATOR2, 2-D	MULTI-GP DIFFUSION PROGRAM	CRNL 360 F4	156
0 F+FAP	RS P T=	S PHIST1/2/5, MULTI-GP TRANSFER COEFFICIENTS	LRL 709	160
63	RS P T=	FORTRAM TEC, 2-D MULTI-GP SN APPROXIMATION RZ	PW 1604 F	161

L 1604 F63	RS	= 2DF, 2-D	MULTI-GP DISCRETE ORDINATE CODE	UNC-LAS	172	
L 7090 F+FAP	RS PLT=	GAMTEC2,	MULTI-GP CONSTANT CALC 0 TO 10 MEV	BAW	185	
L 1107 F4	RS PLT=	GAMTEC2,	MULTI-GP CONSTANT CALC 0 TO 10 MEV	BAW	185	
1604 F63	RS	T= 2DXYL, 3-D	MULTI-GP FLUX SYNTHESIS PROGRAM CYL PH		192	
F4	RS P T=	VARI-CUIR3, 2-C	MULTI-GP DIFFUSION XY RZ RTH	WAL 7094	264	
O F4	RS P T=	DTF-BURN, 1-D	MULTI-GP DTF4 WITH DEPLETION	LASL 703	269	
	RSBPLT=	CAESAR4/LIBLST, 1-D	MULTI-GP DIFFUSION + LIB	AI 360 F4	270	
	RS P =	COMBCC, COMBINED 8-W	MULTI-LEVEL CONVOLUTION	PP 7040 F4	203	
	RS P =	EDLNCE, FLUX DIST IN	MULTI-PIN FUEL ELEMENT	AGN 7090 F2	237	
GEOM GA	1108 F4	RS P T=	MUSCAT, VIEW FACTOR SHIELDING CODE CAVITY		259	
	ANL 3600 F63	RSBP =	NEARREX, COMPOUND NUCLEUS X-SECTION CALC		171	
7090 F2	RS PLT=	GAM1, FAST	NEUTRON SPECTRUM X-SECTION CALC	GA	32	
1604 F63	RS PLT=	GAM1, FAST	NEUTRON SPECTRUM X-SECTION CALC	CDC	32	
FAP RS PLT=	TEMPEST2, THERMAL		NEUTRON SPECTRUM X-SECTIONS	AI 7090 F+	50	
3 RS PLT=	TEMPEST2, THERMAL		NEUTRON SPECTRUM X-SECTIONS	CDC 1604 F6	50	
	RS PLT=	TEMPEST2, THERMAL	NEUTRON SPECTRUM X-SECTIONS	BOEC 360 F4	50	
7090 F2	RS PLT=	FORM, FAST	NEUTRON SPECTRUM X-SECTION CALC	AI	51	
1604 F63	RS PLT=	FORM, FAST	NEUTRON SPECTRUM X-SECTION CALC	CDC	51	
00 F63	RSBP =	AX1, COUPLED	NEUTRONICS-HYDRODYNAMICS SPHERE	CDC 36	102	
O F2	RSBP =	LIPREGAN1, PC	NEUTRON PENETRATION CALCULATION	DAC 709	123	
F2	RS P =	CONEC, COUPLED	NEUTRONICS-HYDRODYNAMICS SPHERE	LRLL 7090	129	
P =	WEAK EXPLSION, COUPLED		NEUTRON-HYDRODYNAMICS	APCA 7094 F2	145	
2	RSB =	PATCHET, COUPLED	NEUTRONICS-HYDRODYNAMICS CODE	AGN 7090 F	153	
F63	RS P =	AX-TNT, COUPLED	NEUTRONICS-HYDRODYNAMICS SPH	PH 1604	191	
F+CCP RS P T=	FMC-N/FMC-G, PC		NEUTRON, GAMMA-RAY HISTORIES	PH 1604	195	
LDCC RS P =	MCS, MCNTE CARLO		NEUTRON PENETRATION STUDY	LASL 7090 F	202	
P T=	EXPA, ANALYSIS OF PULSED		NEUTRON SOURCE DATA	GESJ 635 F4	258	
I 7094 F2	RS P T=	2PLUS, NON-SPHERICAL	OPTICAL MODEL X-SECTIONS	A	254	
NL 3600 F63	RSBP T=	2PLUS, NON-SPHERICAL	OPTICAL MODEL X-SECTIONS	A	254	
A	KE 7090 F2	RSBP =	NPRFCOP, FUEL CYCLE COSTS PERFORMANCE DAT		146	
3	RSBP =	NEARREX, COMPOUND	NUCLEUS X-SECTION CALC	ANL 3600 F6	171	
	RSBP =	NUCY, SOLUTION OF	NUCLIDE CHAIN EQUATIONS	CRNL 7090 F2	134	
3	RSBP =	NUCY, SOLUTION OF	NUCLIDE CHAIN EQUATIONS	CRNL 1604 F6	134	
	CRNL 7090 F2	RSBP =	NUCY, SOLUTION OF NUCLIDE CHAIN EQUATIONS		134	
	CRNL 1604 F63	RSBP =	NUCY, SOLUTION OF NUCLIDE CHAIN EQUATIONS		134	
	RS P T=	2PLUS, NON-SPHERICAL	OPTICAL MODEL X-SECTIONS	AI 7094 F2	254	
	RSBP T=	2PLUS, NON-SPHERICAL	OPTICAL MODEL X-SECTIONS	ANL 3600 F63	254	
ROCK, SPACE POWER PLANT DESIGN			OPTIMIZATION	AI 7090 F2	RS = C	112
HOCK, SPACE POWER PLANT DESIGN			OPTIMIZATION	AI 7090 F2	RS = S	114
	=	MOPEXPT, REACTOR WEIGHT	OPTIMIZATION STUDY	PH 1604 F63	RS	190
	RS P =	SHOE, SHIELD WEIGHT	OPTIMIZATION DOSE CALC	AI 7094 F2		197
TUDY GA	7044 F+FAP	RS P T=	OPUS, POWER PLANT PERFORMANCE AND PRICE S			226
	DTF, 1-D MULTI-GROUP DISCRETE		ORDINATE CALC	UNC 1604 F63	RS PLT=	144
=	DTF2, 1-D MULTI-GP DISCRETE		ORDINATE CALC	AI 7090 F2	RS PLT	151
	ANISN, 1-D MULTI-GP DISCRETE		ORDINATE CALC	AI 360 F4	RSBFLT=	151
=	2DF, 2-D MULTI-GP DISCRETE		ORDINATE CODE	UNC-LASL 1604 F63	RS	172
=	DTF4, 1-D MULTI-GP DISCRETE		ORDINATE PROGRAM	LASL 7030 F4	RS P T	209
=	DTF4, 1-D MULTI-GP DISCRETE		ORDINATE PROGRAM	LRC 7094 F4	RS P T	209
=	DTF4, 1-D MULTI-GP DISCRETE		ORDINATE PROGRAM	LASL 6600 F4	RS P T	209
=	DTF4, 1-D MULTI-GP DISCRETE		ORDINATE PROGRAM	EEC 625 F4	RS P T	209
=	DTF4, 1-D MULTI-GP DISCRETE		ORDINATE PROGRAM	ANL 360 F4	RS P T	209
-D MULTI-GP DIFFUSION PROGRAM						
F NUCLIDE CHAIN EQUATIONS						
M YIELD FROM REACTION OR DECAY						
IGN DECAY CHAIN ANALYSIS						
-GROUP DIFFUSION XYZ GEOMETRY						
2-GROUP DIFFUSION SLAB CYL						
-GROUP DIFFUSION SLAB CYLINDER						
2-GP DIFFUSION CYLINDER SLAB						
F NUCLIDE CHAIN EQUATIONS						
O MULTI-GP DIFFUSION PROGRAM						
	CRNL 360 F4	RS P T=	EXTERMINATOR2, 2			156
	CRNL 1604 F63	RSBP =	NUCY, SOLUTION C			134
	CRNL 1604 F63	RS P =	ISCTCPES, MAXIMU			175
	CRNL 1604 F63	RS F =	ISCRUACH, REACT			180
	CRNL 7090 F2	RS F T=	WHIRLAWAY, 3-C 2			32
	CRNL 7090 F2	RS F T=	ECLIPDISE2, 2-C			35
	CRNL 7090 F2	RS F T=	2CGRAND, 2-D FEW			40
	CRNL 7090 F2	RS F T=	ECLIPDISE3A, 2-D			87
	CRNL 7090 F2	RSBP =	NUCY, SOLUTION C			134
	CRNL 7090 F+FAP	RS F T=	EXTERMINATOR, 2-			156

IGN DECAY CHAIN ANALYSIS	GRNL 7090 F2	RS F =	ISECRUNCH, REACT	180
TI-GP DIFFUSION DEFLECTION CODE	ORNL 7050 F+FAP	RS F 1=	ASSAULT, 2-D MLL	240
7090 F2 RS =	WEC, W-DSN		OUTPUT TAPE EDIT REACTION RATES	132
EFFECTIVE X-SECTION CALC FROM DSN	OUTPUT PW	1604 LAG1	RS F =	DTX, EFF
+MAP RS P T=	GAROL, RESONANCE		OVERLAP AND LATTICE EFFECTS	GA 7044 F
GARGCYCLE, FUEL CYCLE ANALYSIS	PARTIAL REFUEL	GA 7044 F4	RS P T=	260
ON 2APL 6600 F+ASC	RS T=	PDQ7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLET		R275
RSEP =	LIPRECAN1, PC NEUTRON	PENETRATION CALCULATION	CAC 7090 F2	122
P =	MCS, MONTE CARLO NEUTRON	PENETRATION STUDY	LASL 7090 FLCCO	RS
=	NPRFCOP, FUEL CYCLE COSTS	PERFORMANCE DATA	KE 7090 F2	RSEP
P =	WAMPUM, FUEL CYCLE COSTS	PERFORMANCE STUDY	GA 7044 F4	RS
MAP RS P T=	GPUS, POWER PLANT	PERFORMANCE AND PRICE STUDY	GA 7044 F+	226
7090 F2 RS =	PERT, 1-D	PERTURBATION FOR AIM AND FCG CODES	AI	30
1604 F63 RS =	PERT, 1-D	PERTURBATION FOR AIM AND FCG CODES	CCC	30
360 F4 RS F =	PERT, 1-D	PERTURBATION FOR AIM AND FCC CODES	EDEC	30
1604 F63 RS =	TDP, 2-D	PERTURBATION TDC OR 2DXY FLX INPLT	PW	159
DES AI 7090 F2 RS =	PERT, 1-D	PERTURBATION FOR AIM AND FCG CC		30
DES CCG 1604 F63 RS =	PERT, 1-D	PERTURBATION FOR AIM AND FCG CC		30
DES BDEC 360 F4 RS P =	PERT, 1-D	PERTURBATION FOR AIM AND FCC CC		30
AD RSB =	EURP4, GAMMA-RAY	PHOTOFRACTION SOLID CRYSTAL	UM 7090 F	169
AD RSB =	EURP5, GAMMA-RAY	PHOTOFRACTION WELL CRYSTAL	UM 7090 F	170
7090 F+FAP RS T=	4RESTRAINT	PIPE STRESS, MAXIMUM MOMENT CALC	AI	109
DY FW 1604 F62 RS P T=		PIP, CENTRIFUGAL PUMP IMPELLER DESIGN STU		187
S GA 7044 F4 RS P T=		PIZZA, PLANE STRESS ANALYSIS OF 2-D BODIE		230
108 F4 RS P =	SAFE-PLANE,	PLANE STRESS ANALYSIS, 2-D BODIES	GA 1	252
A 7044 F4 RS P T=	PIZZA,	PLANE STRESS ANALYSIS OF 2-D BODIES	G	230
RS =	CROCK, SPACE POWER	PLANT DESIGN OPTIMIZATION	AI 7090 F2	112
RS =	SHOCK, SPACE POWER	PLANT DESIGN OPTIMIZATION	AI 7090 F2	114
C44 F+MAP RS P T=	GPUS, POWER	PLANT PERFORMANCE AND PRICE STUDY	GA 7	226
RSEP T=	CROSSPLCT, SC4020	PLOTS FROM X-SECTION TAPES	CA 7044 F4	207
094 F2 RS T=	CPS, SC4020	PLOTS FROM SCISRS X-SECTION TAPES	WAL 7	239
=	EURP1, DETECTOR EFFICIENCY	POINT SOURCE	UM 7090 MAC	RSE
=	EURP3, DETECTOR EFFICIENCY	POINT SOURCE	UM 7090 MAC	RSE
7044 F4 RS T=	FLCOST5,	POINT-KINETICS WITH 2-D HEAT TRANSFER	GA	205
T=	FLARE, 3-D REACTIVITY AND	POWER DISTRIBUTION	CCC 3600 F63	RSEP
T=	FLARE, 3-D REACTIVITY AND	POWER DISTRIBUTION	GESJ 635 F4	RS P
=	GASP2, 1-D FEW-GP DIFFUSION	POWER DIST SEARCH	CA 7044 F4	RS P T
GA 7044 F+MAP RS P T=	GPUS,	POWER PLANT PERFORMANCE AND PRICE STUDY		226
90 F2 RS =	CROCK, SPACE	POWER PLANT DESIGN OPTIMIZATION	AI 70	112
90 F2 RS =	SHOCK, SPACE	POWER PLANT DESIGN OPTIMIZATION	AI 70	114
SA DOUBLE SN APPROX SLAB GEOM	PP 7090 F2	RS F =	MIST, 1-D FEW-GP	55
P SN APPROXIMATION CYLINDER	PP 7040 F4	RS F T=	TCFIC, 1-D FEW-G	148
P SN APPROXIMATION CYLINDER	PP 7090 F2	RS F T=	TCFIC, 1-D FEW-G	148
B-W MULTI-LEVEL CONVOLUTION	PP 7040 F4	RS F =	COMBCC, COMBINED	202
AL SAFETY ANALYSIS PROGRAM	PP 7040 MAP	RSEP 1=	RSAC, RADICLOGIC	265
PTURE CA 7044 F4 RS T=		PRECON, HTGR CONTAINMENT PRESSURE POST RU		226
P2A, SN X-SECTION LIBRARY TAPE	PREPARATION	PW 1604 F63	RS =	CS
SP1, SN X-SECTION LIBRARY TAPE	PREPARATION	PW 1604 F63	RS =	C
7090 F2 RS P T=	DPC, DATA	PREPARATION FOR 2-D DESIGN PROGRAMS	LASL	234
F2 RSEP T=	PTH1, BLOWDOWN	PRESSURE TEMPERATURE HISTORY	KE 7094	155
T=	PRECON, HTGR CONTAINMENT	PRESSURE POST RUPTURE	GA 7044 F4	RS
S, POWER PLANT PERFORMANCE AND	PRICE STUDY	GA 7044 F+MAP	RS P T=	CFL
RS P =	RAC2, HTGR FISSION	PRODUCT ACTIVITY DIST STUDY	GA 7044 F4	231
7094 F4 RS P =	CAMMA-P,	PRODUCTION X-SECTIONS FOR GAMMA-RAYS	GEC	235
RY KE 7094 F2 RSEP T=		PTH1, BLOWDOWN PRESSURE TEMPERATURE HISTO		155
RS P T=	EXPN, ANALYSIS OF	PLUSEC NEUTRON SOURCE DATA	GESJ 635 F4	258
63 RS P T=	PIP, CENTRIFUGAL	PUMP IMPELLER DESIGN STUDY	PW 1604 F	187
MULTI-GP SN APPROXIMATION RZ	PW 1604 F63	RS F T=	FORTRAN TDC, 2-D	161
OR FLCCO2 INSTRUCTION SET	PW 1604 F+CDP	RS F T=	LAC, ASSEMBLER F	186
PUMP IMPELLER DESIGN STUDY	PW 1604 F63	RS F T=	FIP, CENTRIFUGAL	187
R FUNCTION EVALUATION	PW 1604 F63	RS F =	CMFXMAT, TRANSFE	188

OF SN CONSTANTS FOR DSN TDC	PW	1604 F63	RS P =	SNC, CALCULATION	189
R WEIGHT OPTIMIZATION STUDY	PW	1604 F63	RS =	WOPEXPRT, REACTO	190
NEUTRONICS-HYDRODYNAMICS SPH	PW	1604 F63	RS F =	AX-TNT, COUPLED	191
-GP FLUX SYNTHESIS PROGRAM CYL	PW	1604 F63	RS T=	2DXYL, 3-D MULTI	192
ION LIBRARY TAPE PREPARATION	PW	1604 F63	RS =	CSP2A, SN X-SECT	193
ON LIBRARY TAPE PREPARATION	PW	1604 F63	RS =	CSP1, SN X-SECT	194
NEUTRON, GAMMA-RAY HISTORIES	PW	1604 F+COP	RS P T=	FMC-N/FMC-G, MC	195
ATION TDC OR 2DXY FLUX INPUT	PW	1604 F63	RS =	TDP, 2-D PERTURB	199
-SECTION CALC FROM DSN OUTPUT	PW	1604 LAG1	RS P =	DTX, EFFECTIVE X	210
-GP SN APPROX SLAB CYL SPHERE	PW	1604 LAG1	RS P =	MGOSN, 1-D MULTI	211
ONS AI 7090 F+FAP RS LT=	QUICKIE, INFINITE MEDIUM SPECTRUM X-SECT				119
ONS ANL 3600 F63 RSBP =	R101, SPACE-INDEPENDENT KINETICS KEX OPTI				255
ONS WAL 7094 F4 RS P =	R101, SPACE-INDEPENDENT KINETICS KEX OPTI				255
CALC ANL 3600 F63 RSBP =	R102, SPACE-INDEPENDENT INVERSE KINETICS				168
CALC WAL 7094 F4 RS =	R102, SPACE-INDEPENDENT INVERSE KINETICS				168
ANL 3600 F63 RS P T=	R153, PARAMETRIC SITE REQUIREMENT STUDY				172
STUDY GA 7044 F4 RS P =	RAD2, HTGR FISSION PRODUCT ACTIVITY DIST				231
RS = SCARF2, SCATTER FROM	RADIATOR FJNS SNAP GEOM AI 7090 F2				110
PP 7040 MAP RSBP T= RSAC,	RADIOLOGICAL SAFETY ANALYSIS PROGRAM				265
C GESJ 2000 F2 RS P =	RAPTURE, RESONANCE INTEGRAL X-SECTION CAL				176
-DSN OUTPUT TAPE EDIT REACTION	RATES UK-W 7090 F2 RS = WED, W				133
SS LASL 7094 FAP RS P T=	RATH, 2- OR 3-D HEAT CONDUCTION LUMPED MA				242
RY AI 7090 F2 RS P =	RATRAP, DOSE RATE CALCULATION SNAP GEOMET				141
= WED, W-DSN OUTPUT TAPE EDIT	REACTION RATES UK-W 7090 F2 RS				133
ISOTOPES, MAXIMUM YIELD FROM	REACTION OR DECAY ORNL 1604 F63 RS P =				179
7090 F2 RS P = ISOCRUNCH,	REACTION DECAY CHAIN ANALYSIS ORNL				180
1604 F63 RS P = ISOCRUNCH,	REACTION DECAY CHAIN ANALYSIS ORNL				180
635 F4 RS P T= FLARE, 3-D	REACTIVITY AND POWER DISTRIBUTION GESJ				167
3600 F63 RSBP T= FLARE, 3-D	REACTIVITY AND POWER DISTRIBUTION CDC				167
2000 F4 RS P T= FORE, FAST	REACTOR EXCURSION CALCULATIONS GESJ				174
635 F4 RS P T= FORE2, FAST	REACTOR EXCURSION CALCULATIONS GESJ				174
1604 F63 RS = WOPEXPRT,	REACTOR WEIGHT OPTIMIZATION STUDY PW				190
TIONS GESJ 635 F4 RS P T=	REAX, RESOLVED RESONANCE EPITHERMAL X-SEC				257
INC, COINCIDENCE COUNTING DATA	REDUCTION ANL 3600 F63 RSBP = CO				248
E, FUEL CYCLE ANALYSIS PARTIAL	REFUEL GA 7044 F4 RS P T= GARGOYL				260
ION GA 7044 F4 RS P T=	RELOAD-FEVER, 1-D FEW-GP DIFFUSION DEPLET				221
GA 7090 F+FAP RSB T= ZUT,	RESOLVED REGION RESONANCE INTEGRAL CALC				41
ESJ 2000 F2 RS P = DOPIE,	RESOLVED RESONANCE X-SECTION CALC G				177
GESJ 635 F4 RS P T= REAX,	RESOLVED RESONANCE EPITHERMAL X-SECTIONS				257
RSB T= ZUT, UNRESOLVED REGION	RESONANCE INTEGRAL CALC GA 7090 F+FAP				41
SB T= TUZ, UNRESOLVED REGION	RESONANCE INTEGRAL CALC GA 7090 F+FAP R				42
I 7090 F2 RS PLT= ARES2,	RESONANCE INTEGRAL X-SECTION CALC A				89
DC 1604 F63 RS PLT= ARES2,	RESONANCE INTEGRAL X-SECTION CALC C				89
E, X-SECTION CALC ELASTIC SCAT	RESONANCES AI 7090 F+FAP RS PLT= AILMO				147
E, X-SECTION CALC ELASTIC SCAT	RESONANCES AI 360 F4 RS PLT= AILMO				147
J 2000 F2 RS P = RAPTURE,	RESONANCE INTEGRAL X-SECTION CALC GES				176
F2 RS P = DOPIE, RESOLVED	RESONANCE X-SECTION CALC GESJ 2000				177
I 7094 F+MAP RS PLT= TRI1,	RESONANCE INTEGRAL X-SECTION CALC A				208
3600 F63 RSBP T= RIFF-RAFF,	RESONANCE INTEGRAL CALC 2-REG CELL ANL				212
3600 F63 RSBP = MISH-MASH,	RESONANCE INTEGRAL CALC HOMOGENEOUS ANL				214
= FASDOP, X-SECTIONS FROM B-W	RESONANCE DATA GA 7044 F4 RS P				216
A 7044 F+MAP RS P T= GARDL,	RESONANCE OVERLAP AND LATTICE EFFECTS G				219
P = EXT, X-SECTIONS FROM B-W	RESONANCE PARAMETERS WAL 7094 F2 RS				238
F4 RS P T= REAX, RESOLVED	RESONANCE EPITHERMAL X-SECTIONS GESJ 635				257
7044 F+MAP RSBP = UNPACK,	RETRIEVAL FROM SCISRS X-SECTION TAPE GA				206
ING GA 7044 F4 RS P T=	REVISED-GAD, FUEL CYCLE ANALYSIS W/REFUEL				223
CELL ANL 3600 F63 RSBP T=	RIFF-RAFF, RESONANCE INTEGRAL CALC 2-REG				213
RS = SCAR1, SCATTER FROM A	RING SNAP GEOMETRY AI 7090 F2				111
DIFFUSION SLAB CYLINDER SPHERE	ROA 360 F4 RS PLT= FIRE2, 1-D AGE-D				9
DEPENDENT KINETICS W/FEEDBACK	ROA 360 F4 RS P = AIREK3, SPACE-IN				121
M PP 7040 MAP RSBP T=	RSAC, RADIOLOGICAL SAFETY ANALYSIS PROGRA				265

, 2-D MULTI-GP DIFFUSION XY RZ	RTH	WAL	7094 F4	RS P T=	VARI-QUIR3	264	
HTGR CONTAINMENT PRESSURE POST	RUPTURE	GA	7044 F4	RS	T= PRECON,	228	
2-D MULTI-GP SN APPROXIMATION	RZ	PK	1604 F63	RS P T=	FORTTRAN TDC,	161	
N, 2-D FEW-GP S4 APPROXIMATION	RZ	GEOMETRY	LRLL	709 F2	RS	= FIR	7
B, 2-D FEW-GP DIFFUSION BURNUP	RZ	GEOMETRY	GA	7090 F+FAP	RSBP T=	DO	99
LE4, 2-D MULTI-GP DIFFUSION XY	RZ	GEOMETRY	GA	7044 F+MAP	RSBP T=	GAMB	222
IR3, 2-D MULTI-GP DIFFUSION XY	RZ	RTH	WAL	7094 F4	RS P T=	VARI-QU	264
= S4 CYL CELL CODE, 1-D 1-GP	S4	APPROXIMATION	AI	7090 F2	RS		53
= S4 CYL CELL CODE, 1-D 1-GP	S4	APPROXIMATION	CDC	1604 F63	RS		53
2 RS = FIRN, 2-D FEW-GP	S4	APPROXIMATION	RZ	GEOMETRY	LRLL	709 F	7
ON AI 7090 F2 RS =	S4	CYL CELL CODE, 1-D 1-GP	S4	APPROXIMATI			53
ON CDC 1604 F63 RS =	S4	CYL CELL CODE, 1-D 1-GP	S4	APPROXIMATI			53
AI 7090 F2 RS P =	S4	CYL CELL CODE AND TEMPEST COMBINATION					108
LOAD GA 7044 F4 RS P T=	SAFE-AXISYM, STRESS ANALYSIS	AXISYMMETRIC					251
OAD GA 7044 F4 RS P T=	SAFE-PCRS, STRESS ANALYSIS	AXISYMMETRIC					250
DIES GA 1108 F4 RS P =	SAFE-PLANE, PLANE STRESS ANALYSIS	2-D	DO				252
GA 1108 F4 RS P =	SAFE-SHELL, STRESS ANALYSIS	THIN SHELLS					253
RSBP T= RSAC, RADIOLOGICAL	SAFETY ANALYSIS PROGRAM	PP	7040 MAP				265
ENTRY AI 7090 F2 RS =	SAIL, 1-D 1-GP SN APPROXIMATION	SLAB GEOM					52
FT KE 7094 F+MAP RSBP T=	SATURATED BLOWDOWN1, BLOWDOWN ANALYSIS	LO					200
7044 F4 RSBP T=	CROSSPLOT,						
WAL 7094 F2 RS T=	CPS,						
AI 7090 F2 RS =	SC4020 PLOTS FROM X-SECTION TAPES	GA					207
EDM AI 7090 F2 RS =	SC4020 PLOTS FROM SCISRS X-SECTION TAPES						239
AILMOE, X-SECTION CALC ELASTIC	SCAR1, SCATTER FROM A RING SNAP GEOMETRY						111
AILMOE, X-SECTION CALC ELASTIC	SCARF2, SCATTER FROM RADIATOR FINS SNAP-G						110
RS T= SUMMIT, CRYSTALLINE	SCAT RESONANCES AI	7090 F+FAP	RS PLT=				147
7090 F2 RS =	SCAT RESONANCES AI	360 F4	RS PLT=				147
I 7090 F2 RS =	SCARF2, SCATTER FROM RADIATOR FINS SNAP GEOM	AI					110
VER, HAUSER-FESHBACH INELASTIC	SCATTER FROM A RING SNAP GEOMETRY	A					111
7044 F4 RS =	FLANGE1, SCATTERING CDC	1604 F63	RS P =	SAFE			14
F4 RS P =	GASKET, THERMAL SCATTERING LAW X-SECTION CALCULATION	GA					247
SBP = UNPACK, RETRIEVAL FROM	SCATTERING LAW CALCULATION	GA	1108				263
S T= CPS, SC4020 PLOTS FROM	SCISRS X-SECTION TAFE	GA	7044 F+MAP	R			206
-D FEW-GP DIFFUSION POWER DIST	SCISRS X-SECTION TAFES	WAL	7094 F2	R			239
F+FAP RS P T=	DFSR, DATA FILE SEARCH	GA	7044 F4	RS P T=	GASP2, 1		220
FE-SHELL, STRESS ANALYSIS THIN	SERVICE ROUTINES ENDF TAPES	BNL	7090				236
FARSE1A, DOSE RATE FROM SNAP	SHELLS	GA	1108 F4	RS P =	SA		253
BNWL 7090 F2 RSBPLT=	MAC, SHIELD LEAKAGE	AI	7090 F2	RS	=		91
AI 7094 F2 RS P =	SHOE, SHIELD DESIGN MULTIERDUP	SLAB GEOMETRY					143
RS P T=	MUSCAT, VIEW FACTOR SHIELD WEIGHT OPTIMIZATION	DOSE CALC					197
ION AI 7090 F2 RS =	SHOCK, SPACE POWER PLANT DESIGN OPTIMIZAT						114
C AI 7094 F2 RS P =	SHOE, SHIELD WEIGHT OPTIMIZATION	DOSE CAL					197
P RS P T=	ALSITE2, PARAMETRIC SITE REQUIREMENT STUDY	AI	7094 F+FA				172
63 RS P T=	R153, PARAMETRIC SITE REQUIREMENT STUDY	ANL	3600 F				172
N AI 7090 F2 RS LT=	SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETIO						58
N CDC 1604 F63 RS LT=	SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETIO						58
N AI 360 F4 RSBP T=	SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETIO						58
A, 2-D 2-GP DIFFUSION CYLINDER	SLAB	ORNL	7090 F2	RS P T=	EQUIPOISE3		87
A, 2-D 2-GP DIFFUSION CYLINDER	SLAB	CDC	1604 F63	RS P T=	EQUIPOISE3		87
PLT=	FIRE2, 1-D AGE-DIFFUSION	SLAB CYLINDER SPHERE	ROA	360 F4	RS		9
T=	FOG, 1-D FEW-GP DIFFUSION	SLAB CYLINDER SPHERE	AI	7090 F2	RS P		28
T=	FOG, 1-D FEW-GP DIFFUSION	SLAB CYLINDER SPHERE	CDC	1604 F63	RS P		28
AIM6, 1-D MULTI-GP DIFFUSION	SLAB CYL SPHERE	AI	7090 F+FAP	RS PLT=			29
AIM6, 1-D MULTI-GP DIFFUSION	SLAB CYL SPHERE	CDC	1604 F63	RS PLT=			29
IPOISE3, 2-D 2-GROUP DIFFUSION	SLAB CYL	ORNL	7090 F2	RS P T=	EQU		39
GRAND, 2-D FEW-GROUP DIFFUSION	SLAB CYLINDER	ORNL	7090 F2	RS P T=	20		40
GRAND, 2-D FEW-GROUP DIFFUSION	SLAB CYLINDER	CDC	1604 F63	RS P T=	20		40
ULCER, 1-D MULTI-GP DIFFUSION	SLAB CYL SPHERE	AI	7090 F+FAP	RS LT=			118
FAIM, 1-D MULTI-GP DIFFUSION	SLAB CYL SPHERE	AI	7090 F+FAP	RS LT=			120
FAIM, 1-D MULTI-GP DIFFUSION	SLAB CYL SPHERE	CDC	1604 F63	RS PLT=			120

FAIMGS, 1-D MULTI-GP DIFFUSION	SLAB CYL SPHERE	BOEC 360 F4	RS P T=	120	
W-DSN, 1-D MULTI-GP SN APPROX	SLAB CYL SPHERE	UK-W 7090 F2	RS P T=	132	
MGDSN, 1-D MULTI-GP SN APPROX	SLAB CYL SPHERE	PH 1604 LAG1	RS P =	211	
= FFN, 1-D MULTI-GP DIFFUSION	SLAB CYL SPHERE	BNWL 1107 F4	RS P T	241	
MACH1, 1-D MULTI-GP DIFFUSION	SLAB CYL SPHERE	ANL 3600 F63	RS P T=	262	
GRACE1, GAMMA-RAY ATTENUATION	SLAB GEOMETRY	AI 7090 F2	RS P =	45	
GRACE1, GAMMA-RAY ATTENUATION	SLAB GEOMETRY	CDC 1604 F63	RS P =	45	
AIL, 1-D 1-GP SN APPROXIMATION	SLAB GEOMETRY	AI 7090 F2	RS = S	52	
1-D FEW-GP SN DOUBLE SN APPROX	SLAB GEOM PP	7090 F2	RS P = MIST,	59	
MAC, SHIELD DESIGN MULTIGROUP	SLAB GEOMETRY	BNWL 7090 F2	RSBPLT=	142	
P RS PLT= TYCFE3, MONTE CARLO	SLOWING-DOWN DENSITY CALC	AI 7094 F+FA		145	
F2 RS = SAIL, 1-D 1-GP	SN APPROXIMATION	SLAB GEOMETRY	AI 7090	52	
= MIST, 1-D FEW-GP SN DOUBLE	SN APPROX	SLAB GEOM PP	7090 F2	RS P	59
-MAPG-S13, 1-D MULTI-GP DOUBLE	SN APPROX	BNWL 7090 FLOCC	RSEP T= GE	75	
RS P T= W-DSN, 1-D MULTI-GP	SN APPROX	SLAB CYL SPHERE	LK-W 7090 F2	132	
RS P T= TOPIC, 1-D FEW-GP	SN APPROXIMATION	CYLINDER	PP 7040 F4	140	
RS P T= TOPIC, 1-D FEW-GP	SN APPROXIMATION	CYLINDER	PP 7090 F2	140	
T= FORTRAN 100, 2-C MULTI-GP	SN APPROXIMATION	RZ FW 1604 F63	RS P	161	
CD RSEP = 20XY, 2-C MULTI-GP	SN APPROXIMATION	XY GEOM	AGN 7090 FLO	18	
RS P = MCDN, 1-D MULTI-GP	SN APPROX	SLAB CYL SPHERE	PH 1604 LAG1	211	
RS P = SAC, CALCULATION CF	SN CONSTANTS FOR CSA	TOC PH 1604 F63		185	
2 RS P = MIST, 1-D FEW-GP	SN DOUBLE SN APPROX	SLAB GEOM PP	7090 F	59	
W 1604 F63 RS = CSP2A,	SN X-SECTION	LIBRARY TAPE PREPARATION	P	193	
PH 1604 F63 RS = CSP1,	SN X-SECTION	LIBRARY TAPE PREPARATION		194	
F2, SCATTER FROM RADIATOR FINS	SNAP GEOM	AI 7090 F2	RS = SCAR	110	
= SCAR1, SCATTER FROM A RING	SNAP GEOMETRY	AI 7090 F2	RS	111	
SNAPKIN5,5A, 1-REGION KINETICS	SNAP GEOMETRY	AI 7090 F2	RS =	122	
RATRAP, DOSE RATE CALCULATION	SNAP GEOMETRY	AI 7090 F2	RS P =	141	
CRTIMER, DOSE RATE CALCULATION	SNAP GEOMETRY	AI 7090 F2	RS = M	142	
= FARSE1A, DOSE RATE FROM	SNAP SHIELD LEAKAGE	AI 7090 F2	RS	91	
TRY AI 7090 F2 RS =	SNAPKIN5,5A, 1-REGION KINETICS	SNAP GEOM		122	
TOC PH 1604 F63 RS P =	SAC, CALCULATION CF	SN CONSTANTS FOR CSA		185	
BURP4, GAMMA-RAY PHOTOFRAGMENT	SOLID CRYSTAL	UM 7090 MAD	RSE =	165	
RS P = AXTRM, HEAT TRANSFER	SOLID FUEL TUBE BUNCL	LAST 7094 F2		182	
NTS LALL 7090 F+FA RS P T=	SCPHIST1/2/5, MULTI-GP	TRANSFER COEFFICIE		160	
RP1, DETECTOR EFFICIENCY POINT	SOURCE	UM 7090 MAD	RSE = BU	164	
GRP2, DETECTOR EFFICIENCY DISK	SOURCE	UM 7090 MAD	RSE = B	165	
RP3, DETECTOR EFFICIENCY POINT	SOURCE	UM 7090 MAD	RSE = BU	166	
PN, ANALYSIS OF PULSED NEUTRON	SOURCE DATA	GESJ 635 F4	RS P T= EX	258	
RS = DANCFF JR, MODERATOR	SPACE CHORD DIST FUNCT	AEC 7090 F2		150	
I 7090 F2 RS = CROCK,	SPACE POWER PLANT DESIGN	OPTIMIZATION	A	112	
I 7090 F2 RS = SHECK,	SPACE POWER PLANT DESIGN	OPTIMIZATION	A	114	
7090 F2 RS = AIREK3,	SPACE-INDEPENDENT KINETICS	W/FEEEDBACK	AI	121	
A 360 F4 RS P = AIREK3,	SPACE-INDEPENDENT KINETICS	W/FEEEDBACK	RC	121	
I 7094 F+FA RS P T= AIROS,	SPACE-INDEPENDENT KINETICS	W/FEEEDBACK	A	163	
I 360 F4 RS P T= AIRCS,	SPACE-INDEPENDENT KINETICS	W/FEEEDBACK	A	163	
ANL 3600 F63 RSEP = R102,	SPACE-INDEPENDENT INVERSE KINETICS	CALC		166	
WAL 7094 F4 RS = R102,	SPACE-INDEPENDENT INVERSE KINETICS	CALC		166	
ANL 3600 F63 RSEP = R101,	SPACE-INDEPENDENT KINETICS	KEX OPTIONS		255	
WAL 7094 F4 RS P = R101,	SPACE-INDEPENDENT KINETICS	KEX OPTIONS		255	
F4 RS P T= WIGL2, 1-D 2-GP	SPACE-TIME DIFFUSION	3-GECK	BAPL 6600	R274	
S GESJ 2000 F2 RS P =	SPARTA, SPATIALLY-AVERAGED	COPLER EFFECT		170	
SJ 2000 F2 RS P = SPARTA,	SPATIALLY-AVERAGED	COPLER EFFECTS	GE	170	
C 7090 F+FA RSEP LT= LECPARC,	SPECTRA CALCULATION	WITH DEPLETION	WAP	279	
RS PLT= CAM1, FAST NEUTRON	SPECTRUM X-SECTION	CALC	GA 7090 F2	33	
RS PLT= CAM1, FAST NEUTRON	SPECTRUM X-SECTION	CALC	CDC 1604 F63	33	
LT= TEMPEST2, THERMAL NEUTRON	SPECTRUM X-SECTIONS	AI 7090 F+FA RS P		50	
LT= TEMPEST2, THERMAL NEUTRON	SPECTRUM X-SECTIONS	CDC 1604 F63 RS P		50	
LT= TEMPEST2, THERMAL NEUTRON	SPECTRUM X-SECTIONS	BOEC 360 F4 RS P		50	
RS PLT= FORN, FAST NEUTRON	SPECTRUM X-SECTION	CALC	AI 7090 F2	51	
RS PLT= FORN, FAST NEUTRON	SPECTRUM X-SECTION	CALC	CDC 1604 F63	51	

LT= CLICKIE, INFINITE MEDIUM	SPECTRUM X-SECTIONS	AI	7090 F+FAP RS	115
RS P T= THERMOS(ANL), THERMAL	SPECTRUM X-SECTION CALC	ANL	3600 F63	184
094 F+FAP RS P T= EPITHERMOS,	SPECTRUM AND X-SECTION CALCULATION	GEV	7	203
0 F2 RSEPLY= AGN-GAM, FAST	SPECTRUM MULTI-GP CONSTANT CALC	AGN	709	204
APC 7094 F+FAP RS FLT= LASER,	SPECTRUM CALC WITH BURNUP CYL LATTICE	W		249
UPLED NEUTRONICS-HYDRODYNAMICS	SPH PW	1604 F63	RS P = AX-TRT, CO	191
-D AGE-DIFFUSION SLAB CYLINDER	SPHERE ROA	360 F4	RS PLT= FIRE2, 1	9
FEW-GP DIFFUSION SLAB CYLINDER	SPHERE AI	7090 F2	RS P T= FCG, 1-D	28
FEW-GP DIFFUSION SLAB CYLINDER	SPHERE CDC	1604 F63	RS P T= FCG, 1-D	28
-D MULTI-GP DIFFUSION SLAB CYL	SPHERE AI	7090 F+FAP RS	PLT= ATM6, 1	29
-D MULTI-GP DIFFUSION SLAB CYL	SPHERE CDC	1604 F63	RS PLT= ATM6, 1	29
CE2, GAMMA-RAY ATTENUATION CYL	SPHERE GEOM AI	7090 F2	RS P = GRA	46
CE2, GAMMA-RAY ATTENUATION CYL	SPHERE GEOM CDC	1604 F63	RS P = GRA	46
UPLED NEUTRONICS-HYDRODYNAMICS	SPHERE CDC	3600 F63	RSEP = AX1, CO	102
-D MULTI-GP DIFFUSION SLAB CYL	SPHERE AI	7090 F+FAP RS	LT= ULCER, 1	118
-D MULTI-GP DIFFUSION SLAB CYL	SPHERE AI	7090 F+FAP RS	LT= FAIP, 1	120
-D MULTI-GP DIFFUSION SLAB CYL	SPHERE CDC	1604 F63	RS PLT= FAIP, 1	120
-D MULTI-GP DIFFUSION SLAB CYL	SPHERE BOEC	360 F4	RS P T= FAIPOS, 1	120
UPLED NEUTRONICS-HYDRODYNAMICS	SPHERE LRLL	7090 F2	RS P = CONEC, CO	129
-D MULTI-GP SN APPROX SLAB CYL	SPHERE UK-W	7090 F2	RS P T= W-DSN, 1	132
-D MULTI-GP SN APPROX SLAB CYL	SPHERE PW	1604 LAG1	RS P = WDSN, 1	211
-D MULTI-GP DIFFUSION SLAB CYL	SPHERE BNWL	1107 F4	RS P T= HFN, 1	241
-D MULTI-GP DIFFUSION SLAB CYL	SPHERE ANL	3600 F63	RS P T= MACH1, 1	262
DCSE RATE FROM A CLCUD	SRL	360 F4	RS P = CLCUD, GAMMA-RAY	47
1 7090 F2 RS = FUGUE,	STEADY-STATE TEMPERATURE VOID FRACTION	A		48
RS P T= HEATING2, TRANSIENT	STEADY-STATE HEAT TRANSFER	AI	7094 F2	198
ESJ 635 F4 RS P T= PANTA,	STEADY-STATE THERMAL-HYDRAULIC ANALYSIS	G		256
7044 F4 RS P T= SIMGEN,	STEAM GENERATOR DESIGN CRITERIA COSTS	GA		227
APL 2000 F4 RS = WATER,	STEAM TABLES 14.5-14,500PSIA 32-472DEGF	B		R267
CSTS GA 7044 F4 RS P T=	STMGEN, STEAM GENERATOR DESIGN CRITERIA	C		227
RS P T= ELEC, FUEL ELEMENT	STRESS ANALYSIS STUDY	GA	7044 F4	229
44 F4 RS P T= PIZZA, PLANE	STRESS ANALYSIS OF 2-D BODIES	GA	70	230
7044 F4 RS P T= SAFE-PCRS,	STRESS ANALYSIS AXISYMMETRIC LOAD	GA		250
44 F4 RS P T= SAFE-AXISYM,	STRESS ANALYSIS AXISYMMETRIC LOAD	GA	70	251
RS P = SAFE-PLANE, PLANE	STRESS ANALYSIS, 2-D BODIES	GA	1108 F4	252
108 F4 RS P = SAFE-SHELL,	STRESS ANALYSIS THIN SHELLS	GA	1	253
PL 6600 F4 RS T= CYGRO2,	STRESS ANALYSIS CYL FUEL ELEMENT	BA		R266
F+FAP RS T= 4RESTRAINT PIPE	STRESS, MAXIMUM MOMENT CALC	AI	7090	105
C GA 7090 F2 RS T=	SUMMIT, CRYSTALLINE SCATTERING KERNEL CAL			56
4 RS P = FICRC, LSBR FUEL	SHELLING TEMPERATURE STUDY	BAPL	2000 F	R272
CORPORATION, TRANSFER FUNCTION	SYNTHESIS ANL	3600 F63	RSEP T= TRAFI	135
T= 2DXYL, 3-D MULTI-GP FLUX	SYNTHESIS PROGRAM CYL PW	1604 F63	RS	192
S, 1-D FEW-GP DIFFUSION DESIGN	SYSTEM AI	360 F4	RSEP T= THREE	273
, CRITICAL EXPERIMENT ANALYSIS	SYSTEM ENL-SRL	7090 F2	RS FLT= HAMMER	277
, CRITICAL EXPERIMENT ANALYSIS	SYSTEM ENL-SRL	360 F4	RS PLT= HAMMER	277
00 F4 RS = WATER, STEAM	TABLES 14.5-14,500PSIA 32-472DEGF	BAPL	20	R267
ETRIEVAL FROM SCISRS X-SECTION	TAPE CA	7044 F+FAP	RSEP = LAPACK, R	206
RS = WEC, W-DSN OUTPLT	TAPE EDIT REACTION RATES	UK-W	7090 F2	132
= CSP2A, SN X-SECTION LIBRARY	TAPE PREPARATION PW	1604 F63	RS	193
= CSP1, SN X-SECTION LIBRARY	TAPE PREPARATION PW	1604 F63	RS	194
T, SC4020 PLCTS FROM X-SECTION	TAPES GA	7044 F4	RSEP T= CRCSPLC	207
ATA FILE SERVICE ROUTINES ENCF	TAPES ENL	7090 F+FAP	RS P T= CFSR, D	236
20 PLOTS FROM SCISRS X-SECTION	TAPES WAL	7094 F2	RS T= CFS, SC40	239
LATION OF SN CONSTANTS FOR CSN	TDC PW	1604 F63	RS P = SAC, CALCU	185
RS = TCP, 2-D PERTURBATION	TDC OR 2DXY FLUX INPLT	PW	1604 F63	195
1604 F63 RS P T= FCRTAN	TDC, 2-D MULTI-GP SN APPROXIMATION	RZ	PW	161
PUT PW 1604 F63 RS =	TDC, 2-D PERTURBATION TDC OR 2DXY FLUX IN			195
C GA 7044 F4 RS P T=	TEMCO, 1-D FEW-GP DIFFUSION TEMP CCEF CAL			225
= TEMCC, 1-D FEW-GP DIFFUSION	TEMP CCEF CALC	CA	7044 F4	RS P T
RS = FLGUE, STEADY-STATE	TEMPERATURE VOID FRACTION	AI	7090 F2	48
63 RSEP T= ARGUS, TRANSIENT	TEMPERATURE CALC CYLINDER	ANL	3600 F	152

BP 1= PTH1, BLOWDOWN PRESSURE	TEMPERATURE HISTORY	KE	7094 F2	RS	155
CORE, CORE CONFIGURATION FUEL	TEMPERATURE CODE	GA	7044 F4	RS	233
= FIGRO, LSBR FUEL SWELLING	TEMPERATURE STUDY	BAPL	2000 F4	RS P	R272
IONS AI 7090 F+FAP RS PLT=	TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECT				50
IONS CDC 1604 F63 RS PLT=	TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECT				50
IONS BOEC 360 F4 RS PLT=	TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECT				50
= 8AM, S4 CYL CELL CODE AND	TEMPEST COMBINATION	AI	7090 F2	RS P	108
7090 F+FAP RS PLT=	TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS	AI			50
1604 F63 RS PLT=	TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS	CDC			50
360 F4 RS PLT=	TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS	BOEC			50
O F63 RS P T= THERMOSIANL),	THERMAL SPECTRUM X-SECTION CALC	ANL	360		184
= GAZELLES, GAS-COOLED CORE	THERMAL DESIGN STUDY	GA	7044 F4	RS P	232
RS P T= MANTA, STEADY-STATE	THERMAL-HYDRAULIC ANALYSIS	GESJ	635 F4		256
1108 F4 RS P = GASKET,	THERMAL SCATTERING LAW CALCULATION	GA			263
7094 F2 RS PLT= CYCLOPS1,	THERMODYNAMIC CYCLE ANALYSIS	AI			244
CALC ANL 3600 F63 RS P T=	THERMOSIANL), THERMAL SPECTRUM X-SECTION				184
= SAFE-SHELL, STRESS ANALYSIS	THIN SHELLS	GA	1108 F4	RS P	253
O F4 RSB LT= CLIP, FORM OR	THREDES LIBRARY UTILITY ROUTINE	AI	36		271
EM AI 360 F4 RSBP T=	THREDES, 1-D FEW-GP DIFFUSION DESIGN SYST				273
7090 F+FAP RS P T= VARI-QUIR,	TIME-DEP 2-D MULTI-GP DIFFUSION	WAL			212
ER PP 7040 F4 RS P T=	TOPIC, 1-D FEW-GP SN APPROXIMATION CYLIND				146
ER PP 7090 F2 RS P T=	TOPIC, 1-D FEW-GP SN APPROXIMATION CYLIND				148
ESIS ANL 3600 F63 RSBP T=	TRAFICORPORATION, TRANSFER FUNCTION SYNTH				135
3 RSBP T= TRAFICORPORATION,	TRANSFER FUNCTION SYNTHESIS	ANL	3600 F6		135
5 P T= SOPHIST1/2/5, MULTI-GP	TRANSFER COEFFICIENTS	LRLL	7090 F+FAP R		160
094 F2 RS P = AXFLU, HEAT	TRANSFER MOLTEN FUEL TUBE BUNDLES	LASL	7		182
94 F2 RS P = AXTHRM, HEAT	TRANSFER SOLID FUEL TUBE BUNDLES	LASL	70		183
1604 F63 RS P = CMPXMAT,	TRANSFER FUNCTION EVALUATION	PH			188
2, TRANSIENT STEADY-STATE HEAT	TRANSFER AI	7094 F2	RS P T= HEATING		196
, POINT-KINETICS WITH 2-D HEAT	TRANSFER GA	7044 F4	RS T= BLOOST5		205
= AGN-SIGMA, CALC OF MULTI-GP	TRANSFER MATRICES	AGN	7090 F2	RS P T	243
UGUEL, TRANSIENT FLOW AND HEAT	TRANSFER AI	7094 F2	RS P T= TRANS-F		266
NL 3600 F63 RSBP T= ARGUS,	TRANSIENT TEMPERATURE CALC CYLINDER	A			152
7094 F2 RS P T= HEATING2,	TRANSIENT STEADY-STATE HEAT TRANSFER	AI			198
4 F2 RS P T= TRANS-FUGUEL,	TRANSIENT FLOW AND HEAT TRANSFER	AI	709		268
NSFER AI 7094 F2 RS P T=	TRANS-FUGUEL, TRANSIENT FLOW AND HEAT TRA				268
AI 7094 F+FAP RS PLT=	TRIX1, RESONANCE INTEGRAL X-SECTION CALC				208
FLU, HEAT TRANSFER MOLTEN FUEL	TUBE BUNDLES	LASL	7094 F2	RS P = AX	182
THRM, HEAT TRANSFER SOLID FUEL	TUBE BUNDLES	LASL	7094 F2	RS P = AX	183
CALC GA 7090 F+FAP RSB T=	TUZ, UNRESOLVED REGION RESONANCE INTEGRAL				42
CALC AI 7094 F+FAP RS PLT=	TYCHE3, MONTE CARLO SLOWING-DOWN DENSITY				149
QUID BLOWDOWN ANALYSIS LOFT	UG	360 F4	RS P = WATER-HAMMER, LI		278
O MULTI-GP DIFFUSION PROGRAM	UK-R 7090 F+FAP RSBPLT=	CRAM,	1-D AND 2-		103
-GP SN APPROX SLAB CYL SPHERE	UK-W 7090 F2 RS P T=	W-DSN,	1-D MULTI		132
T TAPE EDIT REACTION RATES	UK-W 7090 F2 RS =	WED,	W-DSN OUTPU		133
HERE AI 7090 F+FAP RS LT=	ULCER, 1-D MULTI-GP DIFFUSION SLAB CYL SP				118
EFFICIENCY POINT SOURCE	UM 7090 MAD RSB =	BURP1,	DETECTOR		164
EFFICIENCY DISK SOURCE	UM 7090 MAD RSB =	BURP2,	DETECTOR		165
EFFICIENCY POINT SOURCE	UM 7090 MAD RSB =	BURP3,	DETECTOR		166
PHOTOFRACTION SOLID CRYSTAL	UM 7090 MAD RSB =	BURP4,	GAMMA-RAY		169
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OUT DISCRETE ORDINATE CALC	UNC 1604 F63 RS PLT=	DTF,	1-D MULTIGR		144
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GA 7090 F+FAP RSB T= TUZ,	UNRESOLVED REGION RESONANCE INTEGRAL CALC				42
7090 F2 RS P = AINFIKE,	URANIUM FUEL CYCLE COST ANALYSIS	AI			55
LT= POMUS, X-SECTION LIBRARY	UTILITY PROGRAM	AI	7094 F+FAP RS		159
T= XLBIT, X-SECTION LIBRARY	UTILITY ROUTINE	ANL	3600 F63 RSBP		181
CLIP, FORM OR THREDES LIBRARY	UTILITY ROUTINE	AI	360 F4 RSB LT=		271
N WAL 7090 F+FAP RS P T=	VARI-QUIR, TIME-DEP 2-D MULTI-GP DIFFUSIO				212
RTH WAL 7094 F4 RS P T=	VARI-QUIR3, 2-D MULTI-GP DIFFUSION XY R2				264

1108 F4	RS P T= MUSCAT,	VIEW FACTOR SHIELDING CODE CAVITY GEOM GA	259
UGUE, STEADY-STATE TEMPERATURE		VOID FRACTION AI 7090 F2 RS = F	48
F4 RS P = AVOID, ANNULAR		VOID X-SECTION CALCULATION GEC 625	276
PENDENT INVERSE KINETICS CALC		WAL 7094 F4 RS = R102, SPACE-INDE	168
DEF 2-D MULTI-GP DIFFUSION		WAL 7090 F+FAP RS P T= VARI-QUIR, TIME-	212
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S FROM SCISRS X-SECTION TAPES		WAL 7094 F2 RS T= CPS, SC4020 PLOT	239
PENDENT KINETICS KEX OPTIONS		WAL 7094 F4 RS P = R101, SPACE-INDE	255
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Y GA 7044 F4 RS P =		WAMPUM, FUEL CYCLE COSTS PERFORMANCE STUD	224
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FT KE 3600 F2 RSBP =		WATER-HAMMER, LIQUID BLOWDOWN ANALYSIS LO	278
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S UK-W 7090 F2 RS =		WED, W-DSN OUTPUT TAPE EDIT REACTION RATE	132
3 RS = WOPEXPT, REACTOR		WEIGHT OPTIMIZATION STUDY PW 1604 F6	190
94 F2 RS P = SHOE, SHIELD		WEIGHT OPTIMIZATION DOSE CALC AI 70	197
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OM BAPL 6600 F4 RS P T=		WIGL2, 1-D 2-GP SPACE-TIME DIFFUSION 3-GE	R274
90 F2 RS P = TED, EDIT OF		W-DSN FORMATTED OUTPUT TAPE UK-W 70	E021
UK-W 7090 F2 RS = WED,		W-DSN OUTPUT TAPE EDIT REACTION RATES	132
HERE UK-W 7090 F2 RS P T=		W-DSN, 1-D MULTI-GP SN APPROX SLAB CYL SP	132
DY PW 1604 F63 RS =		WOPEXPT, REACTOR WEIGHT OPTIMIZATION STU	190
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EST2, THERMAL NEUTRON SPECTRUM		X-SECTIONS CDC 1604 F63 RS PLT= TEMP	50
EST2, THERMAL NEUTRON SPECTRUM		X-SECTIONS BOEC 360 F4 RS PLT= TEMP	50
= FORM, FAST NEUTRON SPECTRUM		X-SECTION CALC AI 7090 F2 RS PLT	51
= FORM, FAST NEUTRON SPECTRUM		X-SECTION CALC CDC 1604 F63 RS PLT	51
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LT= ARES2, RESONANCE INTEGRAL		X-SECTION CALC CDC 1604 F63 RS P	89
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CKIE, INFINITE MEDIUM SPECTRUM		X-SECTIONS AI 7090 F+FAP RS LT= QUI	119
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I 7094 F+FAP RS LT= MOMUS,		X-SECTION LIBRARY UTILITY PROGRAM A	159
S PLT= GRAVE, GROUP-AVERAGING		X-SECTIONS PARAMETERS AI 7094 F+FAP R	162
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= GAM1, FAST NEUTRON SPECTRUM		X-SECTION CALC CDC 1604 F63 RS PLT	33
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S P = GAVER, ENERGY INTERVAL		X-SECTION AVERAGING GA 7044 F4 R	218
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WAL 7094 F2 RS P = EXT,		X-SECTIONS FROM B-W RESONANCE PARAMETERS	238
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= FLANGE1, SCATTERING LAW		X-SECTION CALCULATION GA 7044 F4 RS	247
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3 RS P = ISCTOPES, MAXIMUM YIELD FROM REACTION OR DECAY GRNL 1604 F6			179
CNS LASL 7090 FLOCC RS P = ZOT, GROUP-COLLAPSING OF MULTI-GP X-SECTI			113
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