BNWL-326

AEC
RESEARCH
and
DEVELOPMENT
REPORT

POWER REACTOR DESIGNS
An Annotated Bibliography

COMPILED BY
E. R. APPLEBY

OCTOBER, 1966

BATTELLE-NORTHWEST
BATTELLE MEMORIAL INSTITUTE / PACIFIC NORTHWEST LABORATORY

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POWER REACTOR DESIGNS
An Annotated Bibliography

Compiled By
E. R. Appleby

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October 1966

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BF	BOILING LIGHT WATER REACTORS, FOREIGN
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DF	GAS COOLED REACTORS, FOREIGN
ED	HEAVY WATER MODERATED REACTORS, DOMESTIC
EF	HEAVY WATER MODERATED REACTORS, FOREIGN
FD	LIQUID METAL REACTORS, DOMESTIC
FF	LIQUID METAL REACTORS, FOREIGN
GD	ORGANIC COOLED REACTORS, DOMESTIC
GF	ORGANIC COOLED REACTORS, FOREIGN
HD	PRESSURIZED LIGHT WATER REACTORS, DOMESTIC
HF	PRESSURIZED LIGHT WATER REACTORS, FOREIGN
ID	STEAM OR SUPERCRITICAL WATER COOLED REACTORS, DOMESTIC
IF	STEAM OR SUPERCRITICAL WATER COOLED REACTORS, FOREIGN
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INTRODUCTION

This Report is an annotated bibliography of power and heat reactor design studies, produced by computer printout of information available as of the date of publication.* The computer program will permit frequent up-dating of the information and periodic publication of revisions. The program will also permit subject searches and the preparation of bibliographies from the stored information.

Sections of the Bibliography group the designs into broad reactor types, as listed in the Table of Contents. Each design is given an alpha-numeric code. Pagination follows this alpha-numeric order, with the reactor code number appearing at the upper right hand corner of each page. Tabs are provided for locating the sections.

* The Bibliography has been updated through December 1966.

GLOSSARY
AND
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ACF	ACF INDUSTRIES NUCLEAR PRODUCTS - ERCO DIVISION 508 KENNEDY ST. NW WASHINGTON 11, D.C. DIVISION WAS ACQUIRED BY ALLIS-CHALMERS IN 1959
AEC	U.S. ATOMIC ENERGY COMMISSION WASHINGTON 25, D.C.
AEPSC	AMERICAN ELECTRIC POWER SERVICE CORP. NEW YORK, N.Y.
AEPSCO	AMERICAN ELECTRIC POWER SERVICE CORP. SUBSIDIARY, AMERICAN ELECTRIC POWER CO.
AGN	AEROJET-GENERAL NUCLEONICS SUBSIDIARY OF AEROJET-GENERAL CORPORATION P.O. BOX 78 SAN RAMON, CALIF.
AI	ATOMICS INTERNATIONAL DIV. NORTH AMERICAN AVIATION INC. 8900 DE SOTO AVE. CANOGA PARK, CALIF. AFFILIATED WITH INTERATOM, DANATOM
AIRESEARCH	AIRESEARCH MANUFACTURING CO. DIV. GARRETT CORP. 402 S. 36TH ST. PHOENIX, ARIZONA
ALCO	ALCO PRODUCTS INC. NUCLEAR PROJECTS DEPT. 220 SCHENECTADY, N.Y.
AMES	AMES INSTITUTE FOR ATOMIC RESEARCH IOWA STATE UNIVERSITY AMES, IOWA
AMF	AMF ATOMICS DIV. AMERICAN MACHINE & FOUNDRY CO.

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UTILITIES GROUP
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ARMOUR

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CHICAGO 6, ILLINOIS

ASDA

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ASTRA

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ATL

ADVANCED TECHNOLOGY LABORATORIES
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BMI

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CYNPA

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CYAP

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LA CROSSE, WIS.

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PUBLIC SERVICE-ELECTRIC AND GAS, N.J.
PHILADELPHIA ELECTRIC CO.
DELMARVA POWER AND LIGHT CO.
ATLANTIC CITY ELECTRIC CO.

DETROIT/ED DETROIT EDISON CO.
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DOD DEPARTMENT OF DEFENSE USA

DOUGLAS DOUGLAS AIRCRAFT
MISSILE AND SPACE SYSTEMS DIV.
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DOW DOW CHEMICAL CO.
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DUQUESNE DUQUESNE LIGHT COMPANY
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ECFWONG EAST CENTRAL FLORIDA WEST COAST NUCLEAR GROUP
FLORIDA WEST COAST GROUP
101 SOUTH 5TH STREET
ST. PETERSBURG, FLORIDA

ECNG EAST CENTRAL NUCLEAR GROUP
UTILITIES GROUP

ESADA EMPIRE STATE ATOMIC DEVELOPMENT ASSOC. INC.
4 IRVING PLACE
NEW YORK 3, NEW YORK

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FLORIDA P+L

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FW

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FLORIDA POWER AND LIGHT COMPANY
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GD

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GENERAL ATOMICS DIVISION
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GE

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READING PENNA.

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HITTMAN	HITTMAN ASSOCIATES INC. 4715 E. WABASH AVENUE BALTIMORE, MARYLAND 21215
IITRI	ILLINOIS INST. TECHNOLOGY RES. INST. 10 W. 35 STREET CHICAGO 6, ILLINOIS
INTERNUC	INTERNUCLEAR CO. 7 NORTH BRENTWOOD BLVD. CLAYTON 5, MISSOURI
IOWA-ILLINOIS	IOWA-ILLINOIS GAS AND ELECTRIC CO, DAVENPORT, IOWA
JERSEY CENTRAL	JERSEY CENTRAL POWER AND LIGHT CO, MORRISTOWN, N.J.
JPL	JET PROPULSION LABORATORY CALIF. INST. TECHNOLOGY 4800 OAK GROVE DRIVE PASADENA, CALIF.
KE	KAISER ENGINEERS DIVISION HENRY J. KAISER CO. KAISER BLDG. OAKLAND 12, CALIF.
KIDDE	WALTER KIDDE NUCLEAR LABORATORIES GARDEN CITY, N.Y.
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LAMONT	LAMONT GEOPHYSICAL OBSERVATORY COLUMBIA UNIVERSITY PALISADES, NEW YORK
LASL	LOS ALAMOS SCIENTIFIC LABORATORY P.O. BOX 1663 LOS ALAMOS, N.M.
LEWIS RESEARCH	LEWIS RESEARCH CENTER NATIONAL AERONAUTICS AND SPACE ADMINISTRATION CLEVELAND, OHIO

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LRL	LAWRENCE RADIATION LAB. UNIV. CALIF. LIVERMORE, CALIF.
MA	MARITIME ADMINISTRATION USA
MARQ	MARQUARDT CORPORATION NUCLEAR SYSTEMS DIVISION 16555 SATICOY STREET VAN NUYS, CALIFORNIA
MARTIN	MARTIN-MARIETTA CORPORATION NUCLEAR DIVISION BALTIMORE, MARYLAND
MONSANTO	MONSANTO CHEMICAL COMPANY 800 N. LINDBERGH BLVD. ST. LOUIS 66, MISSOURI
MWD	METROPOLITAN WATER DISTRICT OF S. CALIFORNIA
NAA	NORTH AMERICAN AVIATION ATOMICS INTERNATIONAL DIV.
NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION 400 MARYLAND AVE. SW WASHINGTON, D.C.
NDA	NUCLEAR DEVELOPMENT CORPORATION OF AMERICA UNITED NUCLEAR CORPORATION WHITE PLAINS, N.Y.
NIAGARA MOHAWK	NIAGARA MOHAWK POWER CORP. SYRACUSE, N.Y.
NPG	NUCLEAR POWER GROUP CHICAGO, ILLINOIS
NRDS	NUCLEAR ROCKET DEVELOPMENT STATION JACKASS FLATS, NEVADA
NRTS	NATIONAL REACTOR TEST STATION IDAHO FALLS, IDAHO
NSP	NORTHERN STATES POWER CO.

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PHILADELPHIA, PA.

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PNWL BATTELLE MEMORIAL INSTITUTE
PACIFIC NORTHWEST LABORATORY
PO BOX 999
RICHLAND, WASHINGTON 99352

PRDC POWER REACTOR DEVELOPMENT COMPANY
1911 FIRST STREET
DETROIT 26, MICHIGAN
UTILITIES GROUP

PRWRA PUERTO RICO WATER RESOURCES AUTHORITY
SAN JUAN, PUERTO RICO

PSCC PUBLIC SERVICE COMPANY OF COLORADO
DENVER, COLORADO

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PWAC	PRATT AND WHITNEY AIRCRAFT DIVISION OF UNITED AIRCRAFT EAST HARTFORD, CONNECTICUT
RCA	RADIO CORPORATION OF AMERICA NEW JERSEY
RCPA	RURAL COOPERATIVE POWER ASSOC., ELK RIVER REACTOR, MINNESOTA
ROCHESTER G+E	ROCHESTER GAS + ELECTRIC CORP. ROCHESTER, N.Y.
ROCHESTER G-E	ROCHESTER GAS AND ELECTRIC CORPORATION 89 EAST AVENUE ROCHESTER 4, NEW YORK
RRC	ROYAL RESEARCH CORPORATION HAYWARD, CALIF.
S CAL ED	SOUTHERN CALIFORNIA EDISON CO. LOS ANGELES, CALIF.
SAEA	SOUTHWEST ATOMIC ENERGY ASSOCIATES 306 PYRAMID BUILDING LITTLE ROCK, ARKANSAS UTILITIES GROUP
SAL	SARGENT + LUNDY 140 S. DEARBORN STREET CHICAGO 3, ILLINOIS
SAN DIEGO G+E	SAN DIEGO GAS + ELECTRIC CO. SAN DIEGO, CALIF.
SAP	SANDERSON + PORTER 72 WALL STREET NEW YORK 5, N.Y.
SMUD	SACRAMENTO MUNICIPAL UTILITY DISTRICT SACRAMENTO, CALIF.
SNEC	SAXTON NUCLEAR EXPERIMENT CORPORATION PO BOX 542 READING, PENNSYLVANIA
SNPO	SPACE NUCLEAR PROPULSION OFFICE U.S. ATOMIC ENERGY COMMISSION NATIONAL AERONAUTICS AND SPACE ADMIN.

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TRG	TECHNICAL RESEARCH GROUP 17 UNION SQUARE WEST NEW YORK 3, N.Y.
TRW	THOMPSON RAMO WOOLRIDGE INC. CLEVELAND, OHIO
TVA	TENNESSEE VALLEY AUTHORITY
UAC	UNITED AIRCRAFT CORP. WHITE PLAINS, N.Y.
UCRL	UNIV. CALIF. RADIATION LAB. LIVERMORE, CALIF.
UNC	UNITED NUCLEAR CORPORATION 1730 K ST. N.W. WASHINGTON, D.C.
USAF	UNITED STATES AIR FORCE
USBM	UNITED STATES BUREAU OF MINES WASHINGTON 25, D.C.
USN	U.S. NAVY
VERMONT YANKEE	VERMONT YANKEE NUCLEAR POWER CORPORATION
VITRO	VITRO CORPORATION OF AMERICA 90 PARK AVENUE NEW YORK, NEW YORK 10016
WEPCO	WISCONSIN ELECTRIC POWER COMPANY MILWAUKEE, WISCONSIN

WEST	WESTINGHOUSE ELECTRIC CORPORATION
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WITH SUOMEN VESIVOIMEN GROUP.

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TAIPEI, FORMOSA

FRANCE

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EDF	ELECTRICITE DE FRANCE 2 RUE LOUIS-MURAT PARIS 8, FRANCE CLAMART /SEINE/, FRANCE
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HUNGARY

HUNGARY	NATIONAL ATOMIC ENERGY COMMISSION BUDAPEST, HUNGARY
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AEC ATOMIC ENERGY COMMISSION
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INTERNATIONAL

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EURATOM EUROPEAN ATOMIC ENERGY COMMUNITY
 51-53 RUE BELLIARD
 BRUSSELS, BELGIUM

OECD OECD EUROPEAN NUCLEAR ENERGY AGENCY /ENEA/
 38 BOULEVARD SUCHET
 PARIS 16, FRANCE
 OECD HALDEN REACTOR PROJECT
 PO BOX 173
 HALDEN, NORWAY

 OECD HIGH TEMPERATURE REACTOR PROJECT
 DRAGON
 ATOMIC ENERGY ESTABLISHMENT
 WINFRITH, DORCHESTER, ENGLAND

ISRAEL

IAEC ISRAEL ATOMIC ENERGY COMMISSION
 P.O. BOX 7056
 HAYIRYA
 TEL-AVIV, ISRAEL

ISRATOM ISRAEL NUCLEAR ENGINEERING CO., LTD.
 6 AHUZAT BAYIT ST.
 TEL-AVIV, ISRAEL

ITALY

AGIP AGIP NUCLEARE S.P.A.
 CASELLA POSTALE 4179
 MILAN, ITALY

ANSALDO ANSALDO S. P. A.

JANUARY 1967

BNWL-326

FOREIGN

GLOSSARY AND ADDRESSES

* * * * *

RECAPITO ANSALDO
2 PIAZZA CARIGNANO
GENOA, ITALY

CISE CENTRO INFORMAZIONI STUDI EXPERIENZE
VIA REDECESIO 12
SEGRATE
MILAN, ITALY

CNEN NATIONAL COMMITTEE FOR NUCLEAR ENERGY
/COMITATO NAZIONALE PER L ENERGERIA NUCLEAR/
VIA BELISARIO 15
ROME, ITALY

ENEL ENTE NAZIONALE PER L-ENERGIA ELLETRICA
181 VIA DEL TRITONE
ROME, ITALY

FIAT FIAT S.P. A
SEZIONE ENERGIA NUCLEARE
CORSO MARCONI 10/20
TURIN, ITALY

MONTECATINI MONTECATINI ENERGY DEPT.
NUCLEAR DIVISION
LARGO GUIDO - DONEGANI 1-2
MILAN, ITALY

SELNI SOCIETA ELETTRONUCLEARE ITALIANA
FORO BUONAPARTE 31
MILAN, ITALY

SENN SOCIETA ELETTRONUCLEARE NAZIONALE
VIA TORINO 6
ROME, ITALY

SIMEA SOCIETA ITALIANA MERIDIONALE ENERGIA ATOMICA
VIA S TERESA 35
ROME, ITALY

SORIN SOCIETA RICERCHE IMPIANTI NUCLEARI
VIA FATEBENEFRAELLI 19
MILAN, ITALY

JAPAN

AEC ATOMIC ENERGY COMMISSION OF JAPAN
2-2 KASUMIGASEKI
CHIYODA-KU

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GLOSSARY AND ADDRESSES

* * * * *

TOKYO, JAPAN

FAPIG

FIRST ATOMIC POWER INDUSTRY GROUP
TOKYO BOEKI KAIKAN BLDG.
2, 1-CHOME OTEMACHI
CHIYODA-KU
TOKYO, JAPAN

HITACHI

HITACHI LTD.
ATOMIC ENERGY DEPT.
4, 1-CHOME MARUNOUCHI
CHIYODA-KU
TOKYO, JAPAN

JAERI

JAPAN ATOMIC ENERGY RESEARCH INSTITUTE
1-1 SHIBA TAMURACHO
MINATO-KU
TOKYO, JAPAN

JAORG

JAPAN ATOMIC POWERED ORE CARRIER
RESEARCH GROUP
TOKYO, JAPAN

JAPSD

JAPAN ATOMIC POWERED SHIP DEVELOPMENT CORP.
TOKYO, JAPAN

KANSAI E-P

KANSAI ELECTRIC POWER COMPANY
JAPAN

MAPI

SEE MITSUBISHI

MITSU

MITSUBISHI ATOMIC POWER INDUSTRIES, INC.
OTEMACHI BLDG.
CHIYODA-KU
TOKYO, JAPAN

NAIG

NIPPON ATOMIC INDUSTRY GROUP CO., LTD.
NO. 4 YURAKUCHO 2-CHOME
CHIYODA-KU
TOKYO, JAPAN

SUMIMOTO

SUMIMOTO ATOMIC ENERGY INDUSTRIES, LTD.
5-22 KITAHAMA
HIGASHI-KU
OSAKA, JAPAN

TOKYO ELECTRIC

TOYKO ELECTRIC POWER COMPANY
TOKYO, JAPAN

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* * * * *

ATOMIC ENERGY COMMISSION
77 SECHONG-RO
CHONGRO-KU
SEOUL, KOREA

MEXICO

CNEN COMISION ON NACIONAL DE ENERGIA NUCLEAR
AV, INSURGENTES SUR 1079, TERCER PISO
MEXICO 18, D.F., MEXICO

NETHERLANDS

CAE NUCLEAR ENERGY COMMISSION
/COMMISSIE VOOR ATOOM ENERGIE/
LE VAN DE BOSCHSTRAAT
THE HAGUE, NETHERLANDS

GKN GEMEENSCHAPPELIJKE KERNENERGIECENTRALE
NEDERLAND
JOINT NETHERLAND NUCLEAR POWER STATION

KEMA COMPANY FOR TESTING ELECTROTECH. MATLS
ARNHEM, NETHERLANDS

NERATOOM NERATOOM N.V.
NOORDEINE 38
THE HAGUE, NETHERLANDS

RCN REACTOR CENTRUM NEDERLAND
SCHEVEVINGSEWEG 112
THE HAGUE, NETHERLANDS

SEP SAMENWERKENDE ELECTRICITEITS
PRODUCTIEBEDRIJVEN
UTRECHTSEWEG 310
ARNHEM, NETHERLANDS

SKK STICHTING KERNVOORTSTUWING KOOPVAARDIJSCHEPEN
/FOUNDATION FOR NUCLEAR PROPULSION
OF MERCHANT SHIPS/
NASSAULAAN 13
THE HAGUE, NETHERLANDS

NORWAY

IFA SEE KRE

JANUARY 1967

BNWL-326

FOREIGN

GLOSSARY AND ADDRESSES

* * * * *

JENER JOINT ESTABLISHMENT FOR NUCLEAR ENERGY
RESEARCH
P.O. BOX 175
LILLESTROM, NORWAY
 IFA/INSTITUT FOR ATOMENERGI/ AND
 RCN /REACTOR CENTRUM NEDERLAND/

KRE KJELLER RESEARCH ESTABLISHMENT
/INSTITUT FOR ATOMENERGI/IFE
KJELLER /NEAR LILLESTROM/, NORWAY

NAEC NATIONAL ATOMIC ENERGY COUNCIL
P.O. BOX 175
LILLESTROM, NORWAY

NORATOM NORATOM A/S
HOLMENVEIEN 20
VINDEREN
OSLO, NORWAY

REDERIATOM REDERIATOM
/NUCLEAR RESEARCH GROUP OF NORWEGIAN
 SHIPOWNERS/
P.O. BOX 175
LILLESTROM, NORWAY

PAKISTAN

PAEC PAKISTANI AT. EN. COMMISSION
KARACHI 29, PAKISTAN

PERU

JCEA JUNTA DE CONTROL DE ENERGIA ATOMICA
AVENIDA NICOLAS DE PIEROLA 611
APT. 914
LIMA, PERU

POLAND

CAE OFFICE OF GOVERNMENT HIGH COMMISSIONER
FOR ATOMIC ENERGY
PALACE OF CULTURE AND SCIENCE, 18TH FLOOR
WARSAW, POLAND

INST. NUCL. RES. INSTITUTE OF NUCLEAR RESEARCH

JANUARY 1967

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GLOSSARY AND ADDRESSES

* * * * *

WARSAW, POLAND

SPAIN

CENUSA

CENTRALES NUCLEARES S.A.
C/O 1 HERMOSILLA
MADRID 1, SPAIN

FECSA

FUERZAS ELECTRICAS DE
CATALUNA S.A.
MEMBER OF JOINT COMPANY
FORMED TO BUILD THE
CATALONIA POWER STATION.

FESCA

FUERZAS ELECTRICAS DE CATALUNA S.A.
CATALONIA, SPAIN

JEN

MINISTERIO DE INDUSTRIA
JUNTA DE ENERGIA NUCLEAR
SERRANO 121
MADRID, SPAIN

NUCLENOR

CENTRALES NUCLEAR DEL NORTE S.A.
MADRID, SPAIN

TECNATOM

TECNATOM S.A.
VALLEHERMOSO 30
MADRID, SPAIN

UEM

UNION ELECTRICA MADRILENA S.A.
AV. JOSE ANTONIO 4
MADRID, SPAIN

SWEDEN

AB-ATOM

A.B. ATOMENERGI
LOVHOLMSVAGEN 7
STOCKHOLM 9, SWEDEN

ARC

SWEDISH ATOMIC RESEARCH COUNCIL
DOBELNSGATAN 64
STOCKHOLM VA, SWEDEN

ASEA

ALLMANNA SVENSKA ELECTRISKA A.B.
NUCLEAR POWER DEPARTMENT
VASTERAS, SWEDEN

GOTAVERK

CHANTIERS DE CONSTRUCTION NAVALE DE GOTAVERKE

JANUARY 1967

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GLOSSARY AND ADDRESSES

* * * * *

GOTEBORG 8, SWEDEN
/SWEDISH SHIPBUILDING RESEARCH FOUNDATION/

JOHNSON JOHNSON INDUSTRIAL GROUP
 AXEL JOHNSON INSTITUTE FOR INDUSTRIAL
 RESEARCH
 NYNASHAMM, SWEDEN

KVS SWEDISH STATE POWER BOARD
 NUCLEAR POWER DEPARTMENT
 KARDUANSMAKARGATAN 8
 FACK
 STOCKHOLM 1, SWEDEN

OKAB OSKARSHAMMSVERKETS KRAFTGRUPP AB
 GROUP OF PRIVATE AND MUNICIPAL
 UTILITIES, CENTRAL AND SOUTHERN SWEDEN

OKG SEE OKAB

SYNDKRAFT SYDSVENSKA KRAFT AKTIEBOLAGET
 SOUTH SWEDEN POWER COMPANY

SWITZERLAND

ATOMKRAFT ATOMELEKTRA A.G.
 FORCE ATOMIQUE S.A.
 PRIVATBANK + VERWALTUNGSGESELLSCHAFT
 BARENGASSE 29
 ZURICH 1, SWITZERLAND

BBC BROWN, BOVERI, AND CO, LTD.
 ATOMIC POWER DEPARTMENT
 BADEN, SWITZERLAND

BKW BERNISCHE KRAFTWERKE A.G.
 2 VIKTORIAPLATZ
 BERN, SWITZERLAND
 MEMBER OF SUISATOM

EIR EIDGENOSSISCHE INSTITUT FUR REAKTORFORSCHUNG
 WURENLINGEN, AARGAU, SWITZERLAND
 FEDERAL INSTITUTE FOR REACTOR RESEARCH

ENUSA ENERGIE NUCLEAIRE S.A.
 10 AVENUE DE LA GARE
 LAUSANNE, SWITZERLAND

FCAE FEDERAL COMMISSION FOR ATOMIC ENERGY

JANUARY 1967

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FOREIGN

GLOSSARY AND ADDRESSES

* * * * *

EFFINGERSTRASSE 55
BERN, SWITZERLAND

NOK NORDOSTSCHWEIZERISCHE KRAFTWERK A.G.
BADEN, SWITZERLAND

RAG REACTOR A.G.
WURENLINGEN/A.G.
SWITZERLAND

SNA SOCIETE NATIONALE POUR L'ENCOURAGEMENT
DE LA TECHNIQUE ATOMIQUE INDUSTRIELLE
MEMBERS ARE ENUSA, THERMATON,
AND SUISATOM.

SUISATOM SUISATOM, S.A.
BAHNHOFPLATZ 3
ZURICH 1, SWITZERLAND

SULZER SULZER BROTHERS, LTD.
WINTERTHUR
ZURICH, SWITZERLAND

THERMATON THERMATON, S.A.
ZURCHER STRASSE 9
WINTERTHUR
ZURICH, SWITZERLAND

SWITZN

OK NORDOSTSCHWEIZERISCHE KRAFTWERKE A.G.
BADEN, SWITZERLAND

UNITED ARAB REPUBLIC

UAR AEE UNITED ARAB REPUBLIC
ATOMIC ENERGY ESTABLISHMENT
INSHAS
NR. CAIRO, EGYPT, UNITED ARAB REPUBLIC

UNION OF SOVIET SOCIALIST REPUBLICS

CENTRAL ATOMIC CENTRAL ATOMIC ENERGY UTILIZATION BOARD
USSR

KURCHATOV KURCHATOV ATOMIC ENERGY INSTITUTE
MOSCOW, USSR

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FOREIGN

GLOSSARY AND ADDRESSES

* * * * *

MINISTRY USSR

MINISTRY OF POWER STATIONS
USSR

USSR

SOVIET ATOMIC ENERGY COMMITTEE
/STATE ATOMIC ENERGY COMMITTEE OF THE USSR
COUNCIL OF MINISTERS/
STAROMONETNY PEREULOK 26
MOSCOW, U.S.S.R.

UNITED KINGDOM

AEA

UNITED KINGDOM ATOMIC ENERGY AUTHORITY
11 CHARLES II STREET
LONDON S.W. 1
ENGLAND

AEI-JT

A.E.I. - JOHN THOMPSON NUCLEAR ENERGY CO. LTD
RADBROKE HALL
KNUTSFORD, CHESHIRE
ENGLAND

AERE

ATOMIC ENERGY RESEARCH ESTABLISHMENT
HARWELL
DIDCOT, BERKSHIRE
ENGLAND

APC

ATOMIC POWER CONSTRUCTION, LTD.
29 THEOBALDS ROAD
LONDON W.C. 1
ENGLAND

BAW LTD

BABCOCK AND WILCOX LTD
ATOMIC ENERGY DEPARTMENT
209 EUSTON ROAD
LONDON N.W. 1
ENGLAND

BNX

BRITISH NUCLEAR EXPORT EXECUTIVE
ATOMIC POWER CONSTRUCTION LTD.
THE NUCLEAR POWER GROUP
NUCLEAR DESIGN AND CONSTRUCTION
UK ATOMIC ENERGY AUTHORITY

CEGB

CENTRAL ELECTRICITY GENERATING BOARD
BANKSIDE HOUSE
SUMNER STREET
LONDON S.E. 1
ENGLAND

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★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★
DEHAV

DE HAVILLAND ENGINE CO. LTD.
NUCLEAR POWER GROUP
LEAVESDEN, HERFORDSHIRE
ENGLAND

DER

DOUNREAY EXPERIMENTAL REACTOR ESTABLISHMENT
DOUNREAY
THURSO, CAITHNESS
SCOTLAND

EE

ENGLISH ELECTRIC CO. LTD.
ATOMIC POWER DIVISION
CAMBRIDGE ROAD
WHETSTONE, NEAR LEICESTER
ENGLAND

EE-BW

SEE NUCLEAR DESIGN AND CONSTRUCTION

EE-BW-TW

ENGLISH ELECTRIC, BABCOCK AND WILCOX, AND
TAYLOR WOODROW ATOMIC POWER CONSTRUCTIONS LTD
CAMBRIDGE ROAD
WHETSTONE, NEAR LEICESTER
ENGLAND

FAIREY

FAIREY ENGINEERING LTD.
HESTON, MIDDLESEX
ENGLAND

FW

FOSTER WHEELER LTD.
FOSTER WHEELER HOUSE
3 IXWORTH PLACE
LONDON S.W. 3
ENGLAND

GEC

GENERAL ELECTRIC CO. LTD. OF ENGLAND
ERITH, KENT
ENGLAND

GEC-SC

G.E.C. AND SIMON-CARVES ATOMIC ENERGY CO.
GENERAL ELECTRIC CO. LTD. OF ENGLAND /GEC/
SIMON-CARVES LTD. /SC/

HAG

HUMPHREYS AND GLASGOW LTD.
POWER DIVISION
22 CARLISLE PLACE
LONDON S.W. 1
ENGLAND

HS

HAWKER SIDDELEY NUCLEAR POWER CO. LTD.

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GLOSSARY AND ADDRESSES

* * * * *

SUTTON LANE
LANGLEY, NEAR SLOUGH
BUCKINGHAMSHIRE
ENGLAND

MITCHELL MITCHELL ENGINEERING LTD.
NUCLEAR POWER DIVISION
1 BEDFORD SQUARE
LONDON W.C. 1
ENGLAND

NPG NUCLEAR POWER GROUP
RADBROKE HALL
KNUTSFORD, CHESHIRE
ENGLAND

NPPC NUCLEAR POWER PLANT CO. LTD.
MEMBER OF NPG

RR ROLLS-ROYCE AND ASSOCIATES LTD.
P.O. BOX 31
DERBY
ENGLAND

SC SIMON CARVES LTD.
NUCLEAR POWER DIV.
CHEADLE HEATH
STOCKPORT, CHESHIRE
ENGLAND

SCEB SOUTH OF SCOTLAND ELECTRICITY BOARD
EDINBURGH, SCOTLAND

TNPG THE NUCLEAR POWER GROUP
SEE NPG

UKAEA UNITED KINGDOM ATOMIC ENERGY AUTHORITY
11 CHARLES II STREET
LONDON S.W. 1
ENGLAND

UPC UNITED POWER CO. LTD.
MAGNET HOUSE
KINGSWAY
LONDON W.C. 2
ENGLAND

VICK VICKERS NUCLEAR ENGINEERING LTD.
VICKERS HOUSE
WESTMINSTER

JANUARY 1967

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FOREIGN

GLOSSARY AND ADDRESSES

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LONDON S.W. 1
ENGLAND

NUCLEAR DESIGN

NUCLEAR DESIGN AND CONSTRUCTION
ENGLISH ELECTRIC CO. LTD.
BABCOCK AND WILCOX LTD.

WEST GERMANY

AEG

ALLGEMEINE ELECTRIZITATS GESELLSCHAFT
FRANKFURT-AM-MAIN-SUD 10
GERMANY

AKB

ATOMKRAFT-BAYERN

AKS

ARBEITSGEMEINSCHAFT KERNKRAFTWERKE STUTTGART
STUTTGART, GERMANY

ALKEM

ALKEM
KARLSRUHE, WEST GERMANY
NUKEM
DOW CHEMICAL INTERNATIONAL

APK

ARBEITSGEMEINSCHAFT PROJEKT KERNKRAFTWERK
WIESMOOR
49 HORSTENER STRASSE
HAMBURG-HARBURG, GERMANY

ATOMFORUM

DEUTSCHES GESELLSCHAFT FUR ATOMENERGIE E.V.
WENZELGASSE 2 II
BONN, GERMANY

ATOMKRAFT-BAYERN

GESELLSCHAFT FUR DIE ENTWICKLUNG DER
ATOMKRAFT IN BAYERN M.B.H.
BLUTENBURGSTRASSE 6
MUNICH 2, GERMANY

AVR

ARBEITSGEMEINSCHAFT DEUTSCHER ENERGIE-
VERSORGUNGS UNTERNEHMEN ZUR VORBEREITUNG
DER ERRICHTUNG EINES LEISTUNGSVERSUCHS-
REAKTORS E.V.
LUISENSTRASSE 105
DUSSELDORF, GERMANY

BBC-KRUPP

CONSORTIUM BBC-KRUPP ARBEITSGEMEINSCHAFT
CARL-REISS-PLATZ 1-5

JANUARY 1967

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GLOSSARY AND ADDRESSES

* * * * *

MANNHEIM, GERMANY

BEWAG BERLINER KRAFT UND LICHT
BERLIN, GERMANY

DEUTSCH BAW DEUTSCH BABCOCK UND WILCOX-DAMPFKESSELWERKE
ATOMABTEILUNG
DUISBURGERSTRASSE 375
OBERHAUSEN, GERMANY

DEUTSCH WERFT DEUTSCH WERFT A.G.
HAMBURG 1, GERMANY
/MEMBER OF GKSS/

GEA ATOMKRAFT-BAYERN

GFK GESELLSCHAFT FUR KERNFORSCHUNG M.B.H.
1 FRIEDRICHSPLATZ
KARLSRUHE, GERMANY

GFR GERMAN FEDERAL REPUBLIC /WEST GERMANY/
FEDERAL MINISTRY FOR NUCLEAR ENERGY AND
WATER ECONOMY
LUISENSTRASSE 46
BAD GODESBERG, GERMANY

GKSS GESSELLSCHAFT FUR KERNENERGIEVERTUNG
IM SCHIFFBAU UND SCHIFFFAHRT M.B.H.
/COMPANY FOR THE UTILIZATION OF
NUCLEAR ENERGY IN SHIPBUILDING AND
NAVIGATION/
NORMANNENWEG 10
HAMBURG 6, GERMANY

INTERATOM INTERNATIONALE ATOMREAKTORBAU G.M.B.H.
506 BENSBERG/KOLN
POSTFACH, GERMANY
DEMAG, W.GERMANY
NORTH AMERICAN AVIATION, U.S.,
DEUTSCH BABCOCK AND WILCOX

KBWP KERNKRAFTWERK BADEN-WURTTENBERG
PLANNINGSGESELLSCHAFT M.B.H.
STUTTGART-O, NECKARSTR. 121
GERMANY
NOW KERNKRAFTWERK OBRIGHEIM G.M.B.H.

KERNKRAFTWERK LING KERNKRAFTWERK LINGEN G.M.B.H.
SUBSIDIARY OF VEW WITH AEC

KERNKRAFTWERK OBRIG KERNKRAFTWERK OBRIGHEIM G.M.B.H.

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FOREIGN

GLOSSARY AND ADDRESSES

* * * * *

STUTTGART, GERMANY
FORMERLY KBWP

KFA=JUELICH

KERNFORSCHUNGSANLAGE JUELICH
JUELICH, GERMANY

KFK

KERNFORSCHUNGSZENTRUM KARLSRUHE
KERNREAKTOR BAU- UND BETRIEBS-GESELLSCHAFT
M.B.H.
5 WEBERSTRASSE
KARLSRUHE, GERMANY

KKN

KERNKRAFTWERK NIEDERAICHBACH
SEE KNK

KNK

KERNKRAFTWERK NIEDERAICHBACH G.M.B.H.
NIEDERAICHBACH NUCLEAR STATION

KRB

KERNKRAFTWERK RWE-BAYERNWERK GMBH
GUNDREMMINGEN, GERMANY
KARLSRUHE, GERMANY

KWO

KERNKRAFTWERK OBRIGHEIM
SEE KBWP

MAN

MASCHINENFABRIK AUGSBURG-NURNBERG A.G.
NURNBERG, KATZWANGERSTR. 101
GERMANY

NORDWEST KRAFTWERK

NORDWESTDEUTSCHE KRAFTWERK A.G.)
HAMBURG, GERMANY

RWE

RHEINISCH WESTFALISCHES ELECTRIZITATSWERKE
ESSEN, GERMANY

RWE-BAYERNWERK

KERNKRAFTWERK RWE-BAYERNWERK G.M.B.H.
GUNDREMMINGEN
BAVARIA, GERMANY

SIEMENS

SIEMENS-SCHUCKERTWERKE A.G.
ABTEILUNG REAKTORENTWICKLUNG
WERNER-VON-SIEMENS-STRASSE 50
ERLANGEN, GERMANY

SKW

STUDIENGESELLSCHAFT KERNKRAFTWERKE G.M.B.H.
PEPENSTIEG 10-12
HANOVER, GERMANY

VAK

VEREINIGTE ELEKTRIZITATSWER WESTFALEN AG
RWE

JANUARY 1967

BNWL-326

FOREIGN

GLOSSARY AND ADDRESSES

* * * * *

BAYERNWERK A. G.

VEW

VEREINIGTE ELEKTRIZITATSWERK WESTFALEN A.G.
JOINT ELECTRICITY SUPPLY GROUP

WIESMOOR

SEE APK

YUGOSLAVIA

FEDERAL NUCL

FEDERAL NUCLEAR ENERGY COMMISSION OF
THE SOCIALIST FEDERAL REPUBLIC OF
YUGOSLAVIA
29 KOSANCICEV VENAC
PO BOX 353
BELGRADE, YUGOSLAVIA

UNO

YUGOSLAV INDUSTRIAL SYNDICATE

AQUEOUS HOMOGENEOUS REACTORS
AND
MOLTEN SALT HOMOGENEOUS REACTORS

DOMESTIC

JANUARY 1967

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS. DOMESTIC

AD01

* * * * *

NAME/OWNER	NUCLEAR HYDRAZINE PRODUCTION REACTOR /AGN	
DESIGNER	AEROJET-GENERAL NUCLEONICS	
LOCATION	STUDY, EXPERIMENTAL LOOP IN MTR /AGN-302 LOOP/	
PURPOSE	CHEMONUCLEAR REACTOR, IN-REACTOR PRODUCTION OF HYDRAZINE	
TYPE	HOMOGENEOUS SUSPENSION FUEL	
POWER MWE(MWT)	0	175
COOLANT	ANHYDROUS LIQUID AMMONIA WITH 1 WT. PER CENT HYDRAZINE	
MODERATOR	SUSPENSION FLUID	
FUEL MATERIAL	URANIUM DIOXIDE PARTICLES SUSPENDED IN ANHYDROUS LIQUID AMMONIA	
FUEL ENRICH.	93 PER CENT U-235	
FUEL CHARGE	APPROX. 270 KG. URANIUM DIOXIDE	
BURNUP(REFUEL)	RECYCLED FUEL PLUS ABOUT 0.58 POUND URANIUM DIOXIDE/DAY	
NEUTRON FLUX	APPROX. 10 E+11	
CONTROL	RODS	
COOLANT TEMP.	INLET 100 F	OUTLET 160 F
COOLANT PRESS.	750 PSIA	
REACTOR VESSEL	SPHERICAL VESSEL 8 FT. DIA.	
CONTAINMENT	CANYON TYPE SHIELDING, UNDERGROUND	
REMARKS	URANIUM FUEL COMPOUNDS SOLUBLE IN LIQUID AMMONIA ARE BEING STUDIED. THE NUCLEAR HYDRAZINE PRODUCTION REACTOR CONCEPT DIRECTLY UTILIZES THE URANIUM FISSION PROCESS TO PRODUCE HYDRAZINE FROM LIQUID AMMONIA. BASIS FOR OPERATION IS A HOMOGENEOUS SLURRY OF FINE URANIUM DIOXIDE PARTICLES SUSPENDED IN ANHYDROUS LIQUID AMMONIA. URANIUM DIOXIDE IS SEPARATED FOR RECYCLE TO THE REACTOR AND FUEL REPROCESSING WITH MAKE-UP FUEL ADDED AS REQUIRED. FIRST STUDIES CONSIDERED U	

JANUARY 1967

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS. DOMESTIC

AD01

* * * * *

COMPOUND SUSPENDED IN AN AIR COOLANT
/SMOKE-FUELED/. AGN, GENERAL TIRE + RUBBER, AND
UNION CARBIDE WILL WORK AS A RESEARCH TEAM UNDER
AN AEC CONTRACT IN FISSIOCHEMISTRY FIELD. NITROGEN
FIXATION WITH NATURAL GAS OR COAL GASIFICATION
PRODUCTS FOR FERTILIZER AND INTERMEDIATE CHEMICAL
PRODUCTION WILL BE ONE AREA OF INVESTIGATION.
PROJECT WILL INCLUDE DESIGN OF CHEMONUCLEAR LOOPS
AND REACTORS AND THE DEVELOPMENT OF CERAMIC AND
MIXED-CERAMIC-METAL FUELS. THE REACTOR WORK WILL
TAKE PLACE AT UNION CARBIDES STERLING PARK
FACILITIES.

REFERENCES

NUCLEAR REACTOR MAY MAKE CHEMICALS.
CHEM. AND ENG. NEWS 37, 46-7 /AUGUST 10, 1959/

NUCLEAR HYDRAZINE PROGRAM. FINAL TECHNICAL
ENGINEERING REPORT, MARCH 22 1960-MARCH 22 1961
JH CUSACK, OTHERS
ASD-TR-61-7-840 /JULY 1961/

JANUARY 1967

BNWL-326

AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS, DOMESTIC

AD02

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NAME/OWNER LAPRE /LOS ALAMOS POWER REACTOR EXPERIMENT//AEC

DESIGNER LOS ALAMOS SCIENTIFIC LABORATORY

OPERATOR LOS ALAMOS SCIENTIFIC LABORATORY

LOCATION LOS ALAMOS, N.M.

PURPOSE POWER EXPERIMENT

TYPE AQUEOUS HOMOGENEOUS, CIRCULATING FUEL

POWER MWE(MWT) 0 800 KWT

CRITICAL 1958. TO BE DISMANTLED

COOLANT LIGHT WATER

MODERATOR HYDROGEN IN FUEL SOLUTION

FUEL MATERIAL URANIUM DIOXIDE IN AQUEOUS SOLUTION OF PHOSPHORIC ACID

FUEL ENRICH. 93.4 PER CENT U-235

FUEL CHARGE 6.5 KG, U-235

SPECIFIC POWER 250 KW/KG U-235

NEUTRON FLUX THERMAL AVE. 1×10^{13}
FAST AVE. 6×10^{13}

CONTROL MOVABLE SLEEVE OF BERYLLIUM OXIDE AND GRAPHITE

COOLANT TEMP. INLET 400 F OUTLET 600 F

COOLANT PRESS. INLET 700 PSI OUTLET 600 PSI

REACTOR VESSEL CYLINDRICAL SS, GOLD INNER CLADDING

CONTAINMENT SAFETY ENCLOSURE TANK, CARBON STEEL, COPPER LINED

REMARKS TWO VERSIONS HAVE BEEN STUDIED, BOTH USING PHOSPHORIC ACID SOLUTIONS OF ENRICHED U AS FUEL. IN BOTH SYSTEMS THE HEAT EXCHANGER FOR POWER REMOVAL IS IN THE SAME PRESSURE VESSEL AS THE REACTING FLUID. FUEL SOLUTION CIRCULATION IS BY CONVECTION IN ONE VERSION AND BY FORCED CIRCULATION IN THE OTHER. IN THE CONVECTION FLOW PLANT THE ACID IS ABOUT 95 PER CENT STRENGTH.

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AD02

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WHILE IN THE FORCED CIRCULATION SYSTEM IT IS 50
PER CENT. PURPOSE OF THE EXPERIMENTS WAS TO
DEVELOP HIGH PRESSURE SUPERHEATED STEAM FOR GOOD
TURBINE UTILIZATION.

REFERENCES

THE LOS ALAMOS POWER REACTOR EXPERIMENT,
D FROMAN, ET AL,
PROC. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC
ENERGY 3, 283-6 /1955/

THE FUEL SYSTEM URANIUM DIOXIDE-PHOSPHORIC ACID-
WATER AND LOS ALAMOS POWER REACTOR EXPERIMENT II
BJ THAMER
SECOND U.N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY 7, 54-6 /1958/

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS. DOMESTIC

AD03

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 NAME/OWNER HRE /HOMOGENEOUS REACTOR EXPERIMENT//AEC
 DESIGNER OAK RIDGE NATIONAL LABORATORY
 OPERATOR OAK RIDGE NATIONAL LABORATORY
 LOCATION OAK RIDGE, TENNESSEE
 PURPOSE POWER EXPERIMENT
 TYPE AQUEOUS HOMOGENEOUS, TWO-REGION, CIRCULATING FUEL
 HRE-1 CRITICAL IN 1953 WAS LIGHT WATER COOLED,
 DISMANTLED IN 1954.
 POWER MWE(MWT) 5 10
 CRITICAL 1958, CLOSED OUT 1961
 COOLANT HEAVY WATER SOLUTION
 MODERATOR HEAVY WATER
 FUEL MATERIAL URANYL SULFATE IN HEAVY WATER SOLUTION
 FUEL ENRICH. 93 PER CENT U-235
 FUEL CHARGE 4 KG. U-235
 SPECIFIC POWER 1700 KW/KG FISSIONABLE MATERIAL
 BURNUP(REFUEL) /600 DAYS AT 5 MW/
 CONTROL NONE
 COOLANT TEMP. INLET 494 F OUTLET 572 F /CORE/
 INLET 533 F OUTLET 539 F /BLANKET/
 COOLANT PRESS. 2000 PSI
 REACTOR VESSEL SPHERICAL ZIRCALOY-2 CORE TANK WITHIN SS-CLAD
 CARBON STEEL PRESSURE VESSEL
 CONTAINMENT STEEL-LINED CONCRETE CELL
 REMARKS PRELIMINARY STUDIES OF BOILING HOMOGENEOUS SYSTEMS
 WERE BASED ON URANIUM TRIOXIDE-HEAVY WATER OR
 URANYL SULFATE SLURRIES AS FUEL, WITH HEAVY WATER
 AS COOLANT AND MODERATOR, SINGLE AND TWO-REGION
 DESIGNS WERE STUDIED. HRE-III, PROPOSED FOR
 INVESTIGATING THE THORIUM/U-233 CYCLE, HAS BEEN

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CANCELED. FOSTER WHEELER HAS PROPOSED CONSTRUCTION
OF AN AHR POWER BREEDER USING A BLANKET OF FERTILE
MATERIAL SURROUNDING THE CORE.

REFERENCES

PRELIMINARY DESIGN AND FEASIBILITY STUDY OF A
LARGE-SCALE BOILING SLURRY PLUTONIUM-POWER
PRODUCER.
LC WIDDOES, OTHERS
CF-51-8-84 /1951/

BOILING HOMOGENEOUS REACTOR FOR PRODUCING POWER
AND PLUTONIUM.
HF KARMACK, OTHERS
CF-54-8-238 /1954/

THE HOMOGENEOUS REACTOR EXPERIMENT. A CHEMICAL
ENGINEERING PILOT PLANT.
SE BEALL, CE WINTERS
CHEM. ENG. PROG. 50, 256-63 /MAY 1954/

ULTIMATE HOMOGENEOUS REACTOR, REACTOR AND
FEASIBILITY PROBLEM.
RA THOMAS, OTHERS
CF-54-8-239 /1954/

THE HOMOGENEOUS REACTOR TEST.
SE BEALL, JA SWARTOUT
PROC. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC
ENERGY 3, 263-82 /1955/

CIVILIAN POWER REACTOR PROGRAM, PART III. STATUS
REPORT ON AQUEOUS REACTORS, 1960.
TID-8518 /BOOK 3/

HRE-3 PRELIMINARY DESIGN SUMMARY AND REFERENCE
REPORT.
RH CHAPMAN
CF-59-11-112 /1958/

PROPOSED MODIFICATIONS TO THE HRE CORE
CG LAWSON
CF-60-1-20 /JANUARY 1960/

HRE-II DESIGN REPORT
RH CHAPMAN
ORNL-TM-348 /MARCH 1964/

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS. DOMESTIC

AD04

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NAME/OWNER MSRE /MOLTEN SALT REACTOR EXPERIMENT//AEC

DESIGNER OAK RIDGE NATIONAL LABORATORY

OPERATOR OAK RIDGE NATIONAL LABORATORY

LOCATION OAK RIDGE, TENNESSEE

PURPOSE POWER EXPERIMENT

TYPE MOLTEN SALT FUELED, HOMOGENEOUS, SINGLE REGION,
HIGH POWER DENSITY

POWER MWE(MWT) 0 10

CRITICAL JUNE 1965, FULL POWER MARCH 1966.

COOLANT FUEL MIXTURE /LITHIUM FLUORIDE-BERYLLIUM FLUORIDE/

MODERATOR GRAPHITE

FUEL MATERIAL MOLTEN FLUORIDES, IN PER CENT, 65 LITHIUM-7
FLUORIDE, 21.1 BERYLLIUM FLUORIDE, 5 ZIRCONIUM
FLUORIDE, 0.9 URANIUM FLUORIDE.

FUEL ENRICH. 25-30 PER CENT U-235 FIRST LOAD, LATER FULLY
ENRICHED U FUEL, AND LATER ADDITION OF THORIUM

FUEL CHARGE FUEL VOLUME IN CORE 25 CU. FT.,
70.5 CU. FT. SYSTEM TOTAL

NEUTRON FLUX THERMAL AVE. 2.9×10^{13}

COOLANT TEMP. INLET 1025 F OUTLET 1100 F

REACTOR VESSEL INOR-8 ALLOY, VERTICAL GRAPHITE STRINGERS WITH
MILLED-IN FUEL CHANNELS, PRIMARY /FUEL/ LOOP IS
SEALED IN STEEL CONTAINMENT VESSEL, COOLANT SALT
IS IN 163 U-TUBES.

CONTAINMENT DOUBLE SHELL ON SIDES AND BOTTOM WITH 3 FT. WIDE
ANNULUS FILLED WITH BARYTES SAND AND WATER, TOP
SHIELD IS 7 FT. CONCRETE, REMOVABLE SLABS,
PRESSURE-SUPPRESSION SYSTEM ADDED.

REMARKS INTERNALLY-COOLED GRAPHITE CORE SHELL, AND UNIT
FUEL TUBE DESIGNS WERE STUDIED, THE LATTER CONCEPT
BEING SELECTED FOR DESIGN DEVELOPMENT, FUEL SALT
PASSES THROUGH THE CORE THROUGH TUBES OF
IMPERVIOUS GRAPHITE, IN THE FINAL DESIGN, TO WHICH

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AIRCRAFT REACTOR R+D WILL BE APPLIED, THE CORE IS A GRAPHITE MATRIX PENETRATED BY PARALLEL CHANNELS, WHICH MAY BE CLAD WITH INOR-8. THE WHOLE SYSTEM OPERATES AT A SINGLE PRESSURE. A 10 MWT POWER EXPERIMENT IS UNDER CONSTRUCTION. A PRELIMINARY DESIGN STUDY FOR A 10 MWE, 30 MWT PLANT WITH A LITHIUM FLUORIDE-BERYLLIUM FLUORIDE MODERATOR HAS ALSO BEEN COMPLETED.

MOLTEN CHLORIDE FUELS FOR FAST REACTOR SYSTEMS ARE BEING STUDIED, A 1000 MWE PLANT HAVING BEEN EVALUATED.

OAK RIDGE HAS PROPOSED INSTALLING A MOLTEN SALT EXPERIMENTAL BREEDER REACTOR /MSEB/ OF 100-250 MWE IN THE CORE CAVITY OF EGCR. MSEB WOULD OPERATE AT 1300 F AND PRODUCE SUPERCRITICAL STEAM. CONCEPTUAL DESIGN OF A 1000 MWE PLANT HAS BEEN COMPLETED. SEE AD07.

REFERENCES

MOLTEN SALT BREEDER REACTOR.

HG MACPHERSON

CF-59-12-64 /REV. / 1960/

EXPERIMENTAL MOLTEN SALT FUELED 30 MW POWER REACTOR.

LG ALEXANDER, OTHERS

ORNL-2796 /MARCH 1960/

A 10 MWT MOLTEN-SALT REACTOR EXPERIMENT.

AL BOCH, OTHERS

TRANS. AMERICAN NUCLEAR SOC. 4, 331-2 /NOV. 1961/

THE MOLTEN SALT REACTOR EXPERIMENT.

AL BOCH, OTHERS

POWER REACTOR EXPERIMENTS, VOL. 1, P. 247-92

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA /1962/

MSRE. MOLTEN SALT REACTOR EXPERIMENT.

ES BETTIS, WB McDONALD

NUCLEONICS 22, 66-70 /JAN. 1964/

MOLTEN SALT FAST REACTORS.

LG ALEXANDER

PROC. CONF. ON BREEDING, ECONOMICS, AND SAFETY IN LARGE FAST POWER REACTORS. ARGONNE NATIONAL LAB., OCTOBER 7-10, 1963.

ANL-6792 /P. 553-70/

FUEL PROPERTIES AND NUCLEAR PERFORMANCE OF FAST REACTORS FUELED WITH MOLTEN CHLORIDES.

PA NELSON, OTHERS

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TRANS. AMERICAN NUCLEAR SOC. 8, 153-4 /JUNE 1965/

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS. DOMESTIC

AD05

NAME/OWNER PAR /PENNSYLVANIA ADVANCED REACTOR//WEST

DESIGNER WESTINGHOUSE ELECTRIC CORPORATION

PURPOSE POWER DEMONSTRATION PROPOSAL

TYPE AQUEOUS HOMOGENEOUS, CIRCULATING SOLUTION OR
 SLURRY FUEL, SINGLE REGION

[illegible]

CRITICAL R+D

COOLANT	FUEL SOLUTION /A/
	FUEL SLURRY /B/

MODERATOR HEAVY WATER IN FUEL SOLUTION OR SLURRY
REF. DESIGN 1, SLURRY

FUEL MATERIAL	A - URANYL SULFATE, HEAVY WATER SOLUTION
	B - URANIUM-THORIUM OXIDE, HEAVY WATER SUSPENSION

FUEL GEOMETRY SOLUTION OR SLURRY

FUEL ENRICH. 93 PER CENT U-235

REACTOR VESSEL SPHERICAL STEEL VESSEL 15 FT. DIA./ 6 IN. WALL THICKNESS

REMARKS	PAR THIRD ROUND PROPOSAL BY PENNSYLVANIA POWER AND LIGHT AND BALTIMORE GAS AND ELECTRIC WAS DROPPED IN 1958. AN EXTENDED R+D EFFORT WAS GRANTED BY AEC FOR JUSTIFICATION OF THE SYSTEM, WITH POSSIBLE CONSTRUCTION OF A DEMONSTRATION PLANT.
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REFERENCES PRELIMINARY SYSTEM ANALYSIS FOR THE PENNSYLVANIA
ADVANCED REACTOR
T GOGNIAT, OTHERS
WCAP-433 /1956/

THE PAR HOMOGENEOUS REACTOR PROJECT.
WE JOHNSON, OTHERS
ASME PREPRINT 56-A-170 /1956/

THE PAR HOMOGENEOUS REACTOR PROJECT-PLANT DESIGN
AND OPERATING PROBLEMS.
WE JOHNSON, OTHERS
PROC. AMERICAN POWER CONF. 19, 640-50 /1957/

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PROPOSED 80,000 KILOWATT HOMOGENEOUS REACTOR PLANT
PROCESS AND PLANT DESCRIPTION.

DH FOX, ED.

WCAP-9 /1955/ DECLASSIFIED FEB. 1957

PAR HOMOGENEOUS UNIT.

JE KENTON

NUCLEONICS 15, 166 /SEPTEMBER 1957/

DESIGN CONSIDERATION FOR THE PAR SLURRY
HOMOGENEOUS PLANT.

ATOMIC ENERGY 9, 202-10 /1958/

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS, DOMESTIC

AD06

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NAME/OWNER AQUEOUS HOMOGENEOUS REACTOR DESIGN /BAW

DESIGNER BABCOCK AND WILCOX

PURPOSE POWER AND SPACE HEAT

TYPE AQUEOUS HOMOGENEOUS, TWO REGION.

POWER MWE(MWT) 100 KWE 400 KWT

CRITICAL DESIGN STUDY

COOLANT FUEL SOLUTION

MODERATOR FUEL SOLUTION

FUEL MATERIAL URANYL SULFATE IN LIGHT WATER SOLUTION

FUEL ENRICH. SLIGHT

FUEL CHARGE 4.8 KG. U-235

BURNUP(REFUEL) FUEL ADDITION 580 GM./YEAR
FUEL REPLACEMENT AFTER 5 YEARS

CONTROL AUTOMATIC BY POWER DEMAND

REMARKS A CONCEPTIONAL DESIGN FOR A 150 MWE PLANT HAS BEEN
COMPLETED. THIS CONCEPT IS A TWO-REGION REACTOR
WITH A THORIA PELLET BLANKET.REFERENCES A DESIGN STUDY OF A LOW-POWER AQUEOUS HOMOGENEOUS
BOILING REACTOR POWER PLANT.
BA MONG, OTHERS
BW-AED-502 /JUNE 1, 1955 DECL. APRIL 3, 1959/SINGLE-FLUID TWO-REGION AQUEOUS HOMOGENEOUS
REACTOR POWER PLANT, CONCEPTIONAL DESIGN AND
FEASIBILITY STUDY. FINAL REPORT.
NUCLEAR POWER GROUP, BABCOCK AND WILCOX CO.
NPG-171 /JUNE 1957/

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AQ, HOMOGENEOUS AND MOLTEN SALT REACTORS, DOMESTIC

AD07

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NAME/OWNER	MSCR /MOLTEN SALT CONVERTER REACTOR/ ORNL	
DESIGNER	OAK RIDGE NATIONAL LABORATORY	
TYPE	MOLTEN SALT HOMOGENEOUS REACTOR SINGLE REGION	
POWER MWE(MWT)	1000	2500
CRITICAL	DESIGN STUDY	
COOLANT	FUEL MIXTURE	
MODERATOR	GRAPHITE, UNCLAD	
FUEL MATERIAL	FLUORIDES OF LITHIUM, BERYLLIUM, THORIUM, URANIUM,	
FUEL ASSEMBLY	CORE IS A 20 FT. DIA., 20 FT. HIGH CYLINDRICAL STRUCTURE MADE UP OF 8 IN. DIA. GRAPHITE CYLINDERS FUEL SALT FLOWS UPWARD THROUGH SPACES BETWEEN THE CYLINDERS.	
COOLANT TEMP.	INLET 1100 F	OUTLET 1300 F
COOLANT PRESS.	INLET 80 PSIA	OUTLET 35 PSIA
REACTOR VESSEL	INOR-8 CONSTRUCTION MATERIAL CYLINDRICAL VESSEL 20 FT. 2 IN. ID. WALL THICKNESS 1.7 IN.	
REMARKS	COOLANT SALT SUPERHEATS SATURATED STEAM PRODUCED IN A LOEFFLER BOILER, AND ALSO REHEATS STEAM FROM THE TURBOGENERATORS. PART OF THE SUPERHEATED STEAM GOES TO A HIGH-PRESSURE TURBINE AND REST IS INJECTED INTO THE BOILERS TO GENERATE SATURATED STEAM. PLANT INCLUDES A FUEL PROCESSING SYSTEM.	
REFERENCES	MOLTEN SALT CONVERTER REACTOR. DESIGN STUDY AND POWER COST ESTIMATES FOR A 1000 MWE STATION. LG ALEXANDER, OTHERS ORNL-TM-1060 /SEPT. 1965/	

AQUEOUS HOMOGENEOUS REACTORS
AND
MOLTEN SALT HOMOGENEOUS REACTORS
FOREIGN

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS. FOREIGN

AF01

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NAME/OWNER	PHOEBUS/CEA, FRANCE
DESIGNER	CEA, FRANCE
LOCATION	GRENOBLE, FRANCE
PURPOSE	POWER EXPERIMENT
TYPE	AQUEOUS HOMOGENEOUS, CIRCULATING SLURRY FUEL, BOILING.
POWER MWE(MWT)	0 1
CRITICAL	R+D
COOLANT	LIGHT WATER FUEL SLURRY
MODERATOR	LIGHT WATER FUEL SLURRY
FUEL MATERIAL	URANIUM DIOXIDE IN GLASS MARBLES, SUSPENDED IN WATER
REMARKS	RESEARCH AND DEVELOPMENT PROJECT, PROTOTYPE REPORTEDLY UNDER CONSTRUCTION. BOILING SLURRY CONCEPT. SECOND PHASE OF THE RESEARCH PROGRAM IS TO BE THE STUDY OF A BOILING CYCLONE-REACTOR. PHOEBUS HAS A CYLINDRICAL CORE. LIQUID FUEL IS INJECTED TANGENTIALLY AT THE PERIPHERY OF THE CORE, AND A VORTEX FLOW MAINTAINED.
REFERENCES	IDEAS ON A PROJECT FOR A HOMOGENEOUS REACTOR, J BENEVISTE, OTHERS SECOND U.N. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY 9, 415-20 /1958/

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS, FOREIGN

AF02

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NAME/OWNER	SUS-POP /SUSPENSION POWER ONLY PILE/ /RCN- THE NETHERLANDS
DESIGNER	KEMA, THE NETHERLANDS
OPERATOR	KEMA
LOCATION	ARNHEIM, THE NETHERLANDS
PURPOSE	POWER EXPERIMENT
TYPE	AQUEOUS HOMOGENEOUS, CIRCULATING SLURRY FUEL
POWER MWE(MWT)	250 KWE
CRITICAL	SUB-CRITICAL SYSTEM IN OPERATION 1955
COOLANT	LIGHT WATER FUEL SLURRY
MODERATOR	LIGHT WATER FUEL SLURRY
FUEL MATERIAL	URANIUM DIOXIDE SUSPENSION IN WATER
FUEL ENRICH.	20 PER CENT U-235
CONTROL	BORON CARBIDE SHIM-SAFETY RODS IN THE REFLECTOR
REACTOR VESSEL	STAINLESS STEEL CYLINDER
CONTAINMENT	CONCRETE SHIELD
REMARKS	A SUBCRITICAL SYSTEM HAS BEEN IN OPERATION. THREE- PHASE PROGRAM HEAVY WATER SYSTEM, ENTAILING PRELIMINARY STUDY, DUTCH INDUSTRY STUDY, AND CONSTRUCTION, HAS BEEN INSTITUTED BY SEP WITH ASSISTANCE FROM KEMA, RCN AND U.S. INDUSTRY, REPLACING THE PRIMARY PROJECT. A SYSTEM USING A CIRCULATING FUEL OF THORIUM OXIDE AND URANIUM OXIDE SUSPENDED IN HEAVY WATER WAS STUDIED, AND IS CURRENTLY UNDER DEVELOPMENT. SEE KSTR.
REFERENCES	THE DESIGN OF A SMALL-SCALE PROTOTYPE OF A HOMOGENEOUS REACTOR FUELED WITH URANIUM OXIDE SUSPENSION. H DE BRUYN, OTHERS INTL CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY 3, 116-20 /1955/

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BNWL=326

AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS, FOREIGN

AF03

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NAME/OWNER	KSTR/KEMA=RCN=EURATOM NETHERLANDS
DESIGNER	RCN=KEMA=SEP, THE NETHERLANDS
OPERATOR	REACTOR CENTRUM NEDERLAND
LOCATION	ARNHEIM, THE NETHERLANDS
PURPOSE	POWER EXPERIMENT
TYPE	AQUEOUS HOMOGENEOUS, SLURRY FUEL, PROTOTYPE
POWER MWE(MWT)	250 KW
CRITICAL	DESIGN AND CONSTRUCTION /SEE ALSO SUS=POP/
COOLANT	HEAVY WATER
MODERATOR	HEAVY WATER FUEL SLURRY BERYLLIUM OXIDE REFLECTOR
FUEL MATERIAL	URANIUM/THORIUM OXIDE SUSPENSION IN HEAVY WATER
FUEL ENRICH.	HIGH
CONTROL	UNDETERMINED
COOLANT TEMP.	250 C
REACTOR VESSEL	CYLINDRICAL SS VESSEL, CONED ENDS, 23 IN. LONG/11.05 IN. DIA. 18 LITERS CAPACITY
CONTAINMENT	DOUBLE CONTAINMENT. REACTOR SYSTEM IS IN STEEL COMPARTMENTS BACKED UP BY CONCRETE BIOLOGICAL SHIELD - THE FIRST CONTAINMENT - AND A CONCRETE REACTOR HALL - THE SECOND CONTAINMENT.
REMARKS	SUBCRITICAL REACTOR IN OPERATION, SECOND STEP /PROCESS/ REACTOR UNDER CONSTRUCTION. PART OF SEPS 3-PHASE PROGRAM /SEE SUS=POP/. THE SEP PROGRAM, WITH ASSISTANCE FROM KEMA, RCN, AND US INDUSTRY, LARGELY REPLACE KEMAS AHR DEVELOPMENT PROGRAM. SUSPENSION FLOW IS UPWARD THROUGH VESSEL
REFERENCES	DEVELOPMENT OF A 250 KW AQUEOUS HOMOGENEOUS SINGLE REGION SUSPENSION REACTOR. PJ KREYGER, OTHERS SECOND U.N. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY 9, 427-30 /1958/

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AQ, HOMOGENEOUS AND MOLTEN SALT REACTORS, FOREIGN

AF03

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KSTR, THE KEMA SUSPENSION TEST REACTOR,
NUCLEAR ENG. 8, 437-39 /DEC 1963/

THE AQUEOUS HOMOGENEOUS SUSPENSION REACTOR PROJECT
KEURING VAN ELECTROTECHNISCHE MATERIALEN, N.V.
ARNHEIM, GENEVA, 1964. A/CONF.28/P/635

THE HOMOGENEOUS SUSPENSION REACTOR PROJECT
JJ WEST
EURONUCLEAR 3 /2/, 89-92 /FEB. 1966/

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AQ, HOMOGENEOUS AND MOLTEN SALT REACTORS, FOREIGN

AF04

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NAME/OWNER DAVID POWER REACTOR /ASEA, SWEDEN

DESIGNER ASEA, SWEDEN

PURPOSE CONCEPT FOR POWER, DESIGN STUDY

TYPE SLURRY FUEL HOMOGENEOUS.

CRITICAL CONCEPT

COOLANT HEAVY WATER

MODERATOR HEAVY WATER

FUEL MATERIAL URANIUM THORIUM OXIDES IN HEAVY WATER, SLURRY

REMARKS EXPERIMENTAL WORK IN PROGRESS

REFERENCES A BOILING SLURRY REACTOR CONCEPT.
O. LINDSTROM, B. WIDELL
ASEA RESEARCH, NO. 7, PP. 239-70 /1962/

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS, FOREIGN AF05

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NAME/OWNER MOSEL /MOLTEN SALT EPITHERMAL REACTOR//W GERMANY

DESIGNER KFA, JUELICH, W. GERMANY

PURPOSE POWER

TYPE TWO-FLUID, TWO-REGION MOLTEN SALT REACTOR
MODULAR CONSTRUCTION

POWER MWE(MWT) 500

CRITICAL: CONCEPTUAL DESIGN

COOLANT BLANKET FLUID, INTERMEDIATE HEAT TRANSFER FLUID

FUEL MATERIAL CORE, URANIUM DISSOLVED IN MOLTEN FLUORIDES
BLANKET, THORIUM IN MOLTEN FLUORIDES
SODIUM AND BERYLLIUM FLUORIDES

FUEL GEOMETRY MOLTEN SALT MIXTURE

FUEL ASSEMBLY FUEL CHANNEL DESIGNS INCLUDE PIPES OR PLATES
PLATE-TYPE CORES COULD INVOLVE CONCENTRIC RINGS,
SPIRALS, INVOLUTES, AND PLATES

COOLANT TEMP. 550-640 C

REMARKS A CONCEPTUAL DESIGN AND ECONOMIC STUDY FOR A TWO-
FLUID, TWO-REGION REACTOR, POWER PLANT INCLUDES
THE REACTOR, TURBINE GENERATOR, AND FUEL
PROCESSING FACILITIES.
CORE IS SEPARATED FROM THE SURROUNDING BLANKET BY
A WALL. BLANKET SALT PASSES THROUGH THE CORE
BEFORE FLOWING THROUGH THE BLANKET REGION

REFERENCES THE MOSEL REACTOR CONCEPT
PR KASTEN
GENEVA, 1964, PAPER #538
ATOMPRAXIS 10, 441-43 /1964/

THE MOSEL REACTOR CONCEPT
PR KASTEN
3RD U.N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964. A/CONF.28/P/538

DESIGN CONCEPTS FOR THE CORE STRUCTURE OF A MOSEL
MOLTEN SALT EXPERIMENT REACTOR
PR KASTEN
NUCLEAR STRUCTURAL ENG. 2, 224-32 /1965/

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS. FOREIGN

AF06

NAME/OWNER	SAWA/INST, NUCLEAR RESEARCH, POLAND
DESIGNER	INSTITUTE OF NUCLEAR RESEARCH, POLAND
PURPOSE	POWER BREEDER
TYPE	MOLTEN SALT HOMOGENEOUS, FAST BREEDER
CRITICAL	CONCEPT
COOLANT	ALUMINUM CHLORIDE CLOSED CYCLE CIRCULATION
FUEL MATERIAL	PLUTONIUM-URANIUM-SODIUM CHLORIDES, BOILING
FUEL CHARGE	1000 KG, PLUTONIUM-239 4000 KG, URANIUM-238
SPECIFIC POWER	333 KW/LITER LIQUID SALT
COOLANT TEMP.	INLET 280 C /LIQUID/ OUTLET 800 C /VAPOR/
REMARKS	SODIUM CHLORIDE IN THE CORE COMPOSITION IS INACTIVE DILUENT. THE ALUMINUM CHLORIDE CIR IN A CLOSED CYCLE, THE VAPOR TRANSFERRING H FROM CORE TO AN EXCHANGER OR TURBINE WITH CONDENSER, IT IS THEN RETURNED TO THE CORE LIQUID STATE.
REFERENCES	SALT-BOILING FAST REACTOR SAWA, M TAUBE, OTHERS INR-669/C /DEC. 1965/

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AQ. HOMOGENEOUS AND MOLTEN SALT REACTORS.FOREIGN

AF07

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NAME/OWNER WARS/INST. NUCLEAR RESEARCH, POLAND

DESIGNER INSTITUTE OF NUCLEAR RESEARCH, POLAND

TYPE MOLTEN SALT FAST REACTOR

CRITICAL DESIGN

COOLANT MERCURY

FUEL MATERIAL PLUTONIUM-239 CHLORIDE, URANIUM-238 CHLORIDE,
 SODIUM OR POTASSIUM CHLORIDE DILUENT.

FUEL ASSEMBLY MERCURY IS PUMPED INTO THE FUSED SALT TO GIVE
 A DISPERSED SYSTEM, AND IS HEATED TO BOILING
 TEMPERATURE.

COOLANT TEMP. INLET 356 C OUTLET 740 C

REFERENCES MERCURY-BOILING FUSED-SALT FAST REACTOR, WARS
 M TAUBE, OTHERS
 INR-706/C /APRIL 1966/

BOILING LIGHT WATER REACTORS

DOMESTIC

JANUARY 1967

BNWL=326

BOILING LIGHT WATER REACTORS, DOMESTIC

BD01

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NAME/OWNER PATHFINDER ATOMIC POWER PLANT/AEC,NSP

DESIGNER ALLIS-CHALMERS MANUFACTURING CO.

OPERATOR NORTHERN STATES POWER COMPANY

LOCATION SIOUX FALLS, S. D.

PURPOSE POWER DEMONSTRATION

TYPE BWR, CONTROLLED RECIRCULATION, NUCLEAR SUPERHEAT

POWER MWE(MWT) 58.5 189

CRITICAL MARCH 1964. CORE/BOILER/AND SUPER HEATER DEC. 1964
ON-LINE AT 6-7 MWE, AUG. 1966

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL BOILER, URANIUM DIOXIDE PELLETS 0.348 AND
0.310 IN. DIA.
SUPERHEATER, URANIUM DIOXIDE-SS CERMET 0.020 IN.
THICKFUEL GEOMETRY BOILER, RODS 72 IN. ACTIVE LENGTH
SUPERHEATER, CONCENTRIC TUBES 71.5 IN. ACTIVE
LENGTHFUEL CLADDING BOILER, ZIRCALOY-2 0.04 IN. THICK
SUPERHEATER, SS. 0.006 IN. THICKFUEL ENRICH. BOILER, 2.2 AND 3.2 PER CENT U-235
SUPERHEATER, 93 PER CENT U-235FUEL ASSEMBLY BOILER, 81 RODS, 9X9.
96 ELEMENTS/LOADING
SUPERHEATER, 2 FUELED CERMET TUBES, CONCENTRIC,
412 ELEMENTS/LOADINGFUEL CHARGE BOILER 6560 KG. URANIUM
SUPERHEATER 50 KG. U-235

SPECIFIC POWER 24 KW/KG U IN BOILER

BURNUP(REFUEL) 10,000 MWD/TON U FUEL LIFETIME AVE. 1.3 YEARS
FOR SUPERHEAT, 9 MONTHS.

NEUTRON FLUX THERMAL AVE. 4X10 E+13 /BOILER/

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BD01

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10 E+13 /SUPERHEATER/
 FAST AVE. 2X10 E+14

CONTROL BORON-SS CONTROL RODS, CONTROLLED RECIRCULATION

COOLANT TEMP. INLET 360 F OUTLET 825 F

REACTOR VESSEL CYLINDRICAL, CARBON STEEL, SS LINED.

CONTAINMENT CYLINDRICAL STEEL VESSEL, HEMISPHERICAL TOP AND
 ELLIPSOIDAL BOTTOM, 50 FT. ID./120.5 FT. HIGH.
 ABOUT ONE-HALF BELOW GRADE.

REMARKS THE COOLANT IS CIRCULATED BY PUMPS LOCATED
 EXTERNALLY TO THE REACTOR VESSEL. WET STEAM
 GENERATED IN THE BOILING REGION PASSES THROUGH THE
 NUCLEAR SUPERHEATER FOR CONVERSION TO DRY STEAM
 FOR USE IN THE ELECTRICITY-GENERATING TURBINE.
 THE SECOND SUPERHEAT FUEL LOADING WILL CONSIST OF
 LOW-ENRICHMENT URANIUM DIOXIDE PELLETS, CLADDING
 UNDETERMINED. THE BOILER ELEMENTS WILL PROBABLY
 BE UNCHANGED.

REFERENCES A CONTROLLED RECIRCULATION BOILING WATER REACTOR
 WITH NUCLEAR SUPERHEATER.
 CB GRAHAM, OTHERS
 SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF
 ATOMIC ENERGY 9. 74-8 /1958/

INTERIM FEASIBILITY REPORT, NUCLEAR SUPERHEATER
 FOR A CONTROLLED RECIRCULATION BOILING REACTOR.
 ALLIS-CHALMERS
 AECU-3704 /MAY 1958/

A CONTROLLED RECIRCULATION BOILING WATER REACTOR
 WITH NUCLEAR SUPERHEATER. PATHFINDER ATOMIC
 POWER PLANT FEASIBILITY REPORT.
 ALLIS-CHALMERS
 ACNP-5917 /AUGUST 1959/

PATHFINDER ATOMIC POWER PLANT SAFEGUARDS REPORT.
 PART II. LICENSE APPLICATION.
 NORTHERN STATES POWER CO.
 ACNP-5905 /JANUARY 15, 1962/

DESIGN AND CONSTRUCTION PRACTICE. PATHFINDER AND
 BONUS.
 W MITCHELL
 POWER REACTOR TECHNOLOGY 7/3/. 276-312
 /SUMMER 1964/

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD02

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NAME/OWNER	LA CROSSE BWR/DAIRYLAND POWER
DESIGNER	ALLIS-CHALMERS MANUFACTURING CO.
OPERATOR	DAIRYLAND POWER COOPERATIVE
LOCATION	GENOA, WISCONSIN
PURPOSE	POWER DEMONSTRATION, 2ND ROUND.
TYPE	BWR, FORCED CIRCULATION, DIRECT CYCLE, SINGLE PASS, SINGLE ZONE
POWER MWE(MWT)	50 165
CRITICAL	TARGET AUG. 1966. FULL POWER NOV. 1966
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.350 IN. DIA./1.05 IN. LONG
FUEL GEOMETRY	ROD 0.396 IN. OD./83 IN. ACTIVE LENGTH
FUEL CLADDING	STAINLESS STEEL TUBES 0.020 IN. WALL THICKNESS THICKNESS
FUEL ENRICH.	3.63 PER CENT U-235
FUEL ASSEMBLY	ROD BUNDLE 10/10, ZIRCONIUM AND SS SHROUDS 72 ASSEMBLIES/CORE SS SHROUDS OF INITIAL CORE WILL BE REPLACED PART WAY THROUGH CORE LIFE BY ZIRCONIUM SHROUDS, SHROUD SECTIONS ARE REMOVABLE.
FUEL CHARGE	8600 KG, URANIUM
BURNUP(REFUEL)	INITIAL CORE 12,700 MWD/T
NEUTRON FLUX	THERMAL AVE. 1.5×10^{13}
CONTROL	BORON CARBIDE PELLETS IN INCONEL TUBES CRUCIFORM SHEATHS OF SS CONTROLLED CIRCULATION
COOLANT TEMP.	INLET 285.6 F
COOLANT PRESS	INLET 1350 PSIA

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD02

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REACTOR VESSEL CYLINDRICAL STEEL VESSEL, HEMISPHERICAL ENDS
SS LINING 0.188 IN. THICK
8.25 FT. ID/37 FT. HIGH, 4 IN. WALL THICKNESS WITH
CLADDING
SS INNER THERMAL SHIELD

CONTAINMENT STEEL BUILDING, HEMISPHERICAL DOME
LINED ABOVE-GRADE WITH 9-IN. CONCRETE. DOME IS
UNLINED

REMARKS AEC CONTRACTS AWARDED TO AC AND DAIRYLAND POWER
IN JUNE, 1962. ON-LINE TARGET IS 1966

REFERENCES HAZARDS SUMMARY REPORT FOR CONSTRUCTION
AUTHORIZATION OF THE LA CROSSE BOILING WATER
REACTOR,
ALLIS-CHALMERS MANUFACTURING CO.,
ACNP-62574 /OCTOBER 1962/

LA CROSSE BOILING WATER REACTOR, SAFEGUARDS
REPORT FOR OPERATING AUTHORIZATION,
ALLIS-CHALMERS
ACNP-65544 /VOL. 1-2/ JULY 1965

JANUARY 1967

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BOILING LIGHT WATER REACTORS. DOMESTIC

BD03

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NAME/OWNER SUPERHEAT REACTOR STUDY /AC

DESIGNER: ALLIS-CHALMERS MANUFACTURING CO.

PURPOSE POWER

TYPE BWR NUCLEAR SUPERHEAT AND BWR SUPERHEAT-REHEAT
DESIGNS.

POWER MWE(MWT) 400

CRITICAL DESIGN

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

REMARKS AN INTEGRAL SUPERHEAT REACTOR ISR IS DESIGNED TO
REACH STEAM AT 1450 PSIG AND 1000 F BY 3 PASSES
THROUGH THE BOILER AND SUPERHEATER. A SUPERHEAT-
REHEAT REACTOR SSR CONCEPT WOULD USE TWO REACTORS,
THE STEAM BEING DEVELOPED IN A SUPER HEAT BWR AND
REHEATED IN A SEPARATE SUPERHEAT REACTOR.

REFERENCES APPLIED ATOMICS DEC. 11, 1963 P 6-7.
NEWS RELEASE

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD04

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NAME/OWNER SUPERHEAT REACTOR FOR PROPULSION/AC

DESIGNER ALLIS-CHALMERS MANUFACTURING CO.

PURPOSE SHIP PROPULSION, SURFACE VESSEL

TYPE BWR, NUCLEAR SUPERHEAT

POWER MWE(MWT) 175

CRITICAL DESIGN

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL GEOMETRY RODS, ACTIVE LENGTH 7 FT.

FUEL ASSEMBLY BOILER, 136 ELEMENTS
SUPERHEATER /CENTRAL/, 343 ELEMENTS

CONTROL RODS

REACTOR VESSEL STEEL VESSEL 9.5 FT. ID./30 FT. LONG,
WALL THICKNESS INCLUDING CLAD 5 IN.

CONTAINMENT STEEL VESSEL PLUS LEAD SHIELDING.

REMARKS FULL DESIGN STUDY HAS BEEN DONE FOR GIBBS AND COX,
N. Y.REFERENCES NUCLEAR SUPERHEAT PROPULSION SYSTEM FOR A
PASSENGER LINER.
ALLIS-CHALMERS, ATOMIC ENERGY DIV.
ACNP-6125, SUPPLEMENT 1, /1961/

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BOILING LIGHT WATER REACTORS. DOMESTIC

8D05

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NAME/OWNER ELK RIVER REACTOR/AEC

DESIGNER ALLIS-CHALMERS MANUFACTURING CO.

OPERATOR RURAL COOPERATIVE POWER ASSOCIATION

LOCATION ELK RIVER, MINNESOTA

PURPOSE POWER DEMONSTRATION, 2ND ROUND

TYPE BWR, NATURAL CIRCULATION, INDIRECT CYCLE, SEPARATE SUPERHEAT,

POWER MWE(MWT) 22 64

CRITICAL NOV, 1962. FULL POWER FEB, 1964

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM-THORIUM OXIDE PELLETS 0.407 IN. DIA./0.500 IN. LONG

FUEL GEOMETRY ROD, 5 FT. ACTIVE LENGTH

FUEL CLADDING SS 0.410 IN. ID./0.020 IN. THICK

FUEL ENRICH. 4.3 PER CENT U-235
SPIKE ELEMENTS 5.23 PER CENT

FUEL ASSEMBLY 25 RODS 5X5
148 ASSEMBLIES/CORE
SPIKE ASSEMBLIES 5.23 PER CENT ENRICHED WILL BE LOADED 640 DAYS AFTER STARTUP.

FUEL CHARGE 185 KG. URANIUM

SPECIFIC POWER 341 KW/KG U-235

BURNUP(REFUEL) 10,000 MWD/TON FUEL. AVE. 8730 MWD/T

NEUTRON FLUX THERMAL AVE. 1.55×10^{13}
FAST AVE. 4.8×10^{13}

CONTROL BORON ALLOYED WITH SS CLADDING TUBES AS BURNABLE POISON, SS-BORON ALLOY RODS.

COOLANT TEMP. INLET 450 F

COOLANT PRESS. INLET 940 PSIA

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BOILING LIGHT WATER REACTORS, DOMESTIC

8D05

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REACTOR VESSEL STEEL SHELL, SS CLAD, UPRIGHT CYLINDER 7 FT. ID./
25 FT. HIGH

CONTAINMENT VERTICAL STEEL CYLINDER 74 FT. DIA./115 FT. HIGH.

REMARKS SPIKE ASSEMBLIES WILL INCREASE CORE LIFE. AMOUNT
IS NOT SPECIFIED.

REFERENCES A PROPOSAL FOR A NUCLEAR STEAM GENERATING PLANT
FOR THE RURAL COOPERATIVE POWER ASSOCIATION, ELK
RIVER, MINNESOTA.
ACF IND. INC.
NP-7331 /1958/

ELK RIVER REACTOR QUARTERLY PROGRESS REPORT FOR
JUNE, JULY, AUGUST 1959.
ALLIS-CHALMERS
ACNP-ERR-5 /1959/

FINAL HAZARDS REPORT FOR THE RCPA ELK RIVER
REACTOR AT ELK RIVER, MINNESOTA, AND ADDITIONS
AND CORRECTIONS TO FINAL HAZARDS REPORT FOR THE
ELK RIVER REACTOR AT ELK RIVER, MINNESOTA.
WS FARMER, DG STRAWSON
TID-11734 /JULY 1960/

DESIGN PRACTICE, THE ELK RIVER REACTOR,
POWER REACTOR TECHNOLOGY 5, 33-47 /MARCH 1962/

NUCLEONICS REACTOR FILE NO. 18
ERR, ELK RIVER REACTOR
NUCLEONICS 21 /7/. /JULY 1963/ /FOLDOUT/

TECHNICAL SPECIFICATIONS FOR THE RCPA ELK RIVER
REACTOR AT ELK RIVER, MINNESOTA.
ALLIS-CHALMERS MAF, CO.
TID-21059 /REVISED SEPT. 1, 1961/

JANUARY 1967

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BOILING LIGHT WATER REACTORS. DOMESTIC

BD06

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NAME/OWNER	ZBSR /ZIRCONIUM BOILING-SUPERHEATING REACTOR//AI	
DESIGNER	ATOMICS INTERNATIONAL	
PURPOSE	POWER	
TYPE	BOILING-SUPERHEATING, DIRECT CYCLE, FORCED CIRCULATION.	
POWER MWE(MWT)	300	778
CRITICAL	STUDY	
COOLANT	LIGHT WATER AND STEAM	
MODERATOR	BOILER, LIGHT WATER SUPERHEATER, ZIRCONIUM HYDRIDE	
FUEL MATERIAL	BOILER, URANIUM DIOXIDE PELLETS SUPERHEATER, URANIUM DIOXIDE SINTERED POWDER	
FUEL GEOMETRY	ROD BOILER, 0.394 IN. DIA./0.396 IN. LONG SUPERHEATER, 0.403 IN. DIA.	
FUEL CLADDING	BOILER, ZIRCALOY-2 TUBES, 0.450 IN. OD, SUPERHEATER, SS THIN-WALL TUBES	
FUEL ENRICH.	BOILER, 2.53 PER CENT U-235 SUPERHEATER, 3.39 PER CENT U-235	
FUEL ASSEMBLY	BOILER, 140-ROD BUNDLE, 12X12 WITH 4 CENTRAL RODS REMOVED. ZIRCALOY BOX CONTAINS 5 BUNDLES 84 ASSEMBLIES/BOILER SUPERHEATER, 7-ROD CLUSTER FITTED INTO A 1700-IN. DIA. FLOW CHANNEL IN MODERATOR LOG ASSEMBLY, 16 CHANNELS/LOG, 45 LOGS IN SUPERHEAT REGION	
FUEL CHARGE	BOILER, 28,400 KG. URANIUM SUPERHEATER 12,500 KG. URANIUM	
SPECIFIC POWER	19 KW/KG U	
BURNUP(REFUEL)	10,000 MWD/MTU	/BATCH/
CONTROL	BORON-SS RODS	
COOLANT TEMP.	INLET 593 F.	OUTLET 600 F.
COOLANT PRESS,	1550 PSIG	

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD06

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REACTOR VESSEL CARBON STEEL VESSEL 11 FT. 4 IN. DIA./51 FT. HIGH,
SS LINER.

REMARKS

THE REACTOR CORE CONSISTS OF A CENTRAL SUPERHEAT REGION, AND A PERIPHERAL BOILING REGION, IN WHICH STEAM IS PRODUCED. THE BOILING REGION IS COOLED AND MODERATED BY LIGHT WATER. THE SUPERHEAT REGION CONSISTS OF ZIRCONIUM HYDRIDE MODERATOR LOG ASSEMBLIES, FUEL ASSEMBLIES AND CONTROL RODS. IT IS SEPARATED FROM THE BOILING REGION BY A FLOW BAFFLE, AND IS IN A STEAM ENVIRONMENT DURING OPERATION. A CONCEPT IN WHICH THE ZIRCONIUM HYDRIDE IS USED AS BOTH MODERATOR AND FUEL CLADDING MATERIAL WAS BRIEFLY INVESTIGATED, THE INTEGRAL FUEL-MODERATOR CONCEPT, AS WELL AS A 50-MWE CONCEPT.

REFERENCES

EVALUATION OF ZIRCONIUM HYDRIDE AS MODERATOR IN
INTEGRAL BOILING WATER-SUPERHEAT REACTORS,
JD GYLFE, OTHERS
NAA-SR-5943 /MARCH 1962/

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD07

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NAME/OWNER BWR DUAL PURPOSE STUDY/AMF-MITCHELL

DESIGNER AMF-ATOMICS, MITCHELL ENG.

PURPOSE POWER, DUAL PURPOSE

TYPE BWR

POWER MWE(MWT) 25 110
COMBINED OUTPUT FROM NUCLEAR AND GEOTHERMAL
WOULD BE 50 MWE

CRITICAL STUDY

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL GEOMETRY RODS

FUEL CLADDING SS

FUEL ENRICH. 2.2 PER CENT U-235

FUEL ASSEMBLY 8X8 ROD ASSEMBLY IN ZIRCONIUM BOX

CONTROL SILVER-INDIUM RODS

COOLANT TEMP. 476 F

REMARKS A STUDY SUBMITTED TO ITALY'S LARDERELLO CO. ON THE
FEASIBILITY OF INTEGRATING A BWR INTO THE
LARDERELLO GEOTHERMAL STEAM GENERATING SYSTEM.
COMPLETION OF STUDY IN 1962, AMF HAS DESIGNED A
DUAL PURPOSE REACTOR FOR POWER AND WATER
DESALINATION BASED ON THIS STUDY.

REFERENCES NUCLEAR POWER FEB. 1962 P. 77.
NEWS RELEASE.

NUCLEONICS 21, 27/APRIL 1963/.
NEWS RELEASE

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD08

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NAME/OWNER BWR-PWR STUDY/AMF

DESIGNER AMF ATOMICS

PURPOSE DUAL PURPOSE. POWER AND WATER DESALINATION.

TYPE BWR-PWR, BOILING-SUPERHEATING.

POWER MWE(MWT) 110

CRITICAL STUDY

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL GEOMETRY ROD

FUEL CLADDING SS TUBES

FUEL ENRICH. 2.2 PERCENT U-235

FUEL ASSEMBLY 8x8 ROD ASSEMBLY, ZIRCONIUM BOX

CONTROL RODS

REMARKS THE REACTOR WOULD BE USED WITH A MULTISTAGE FLASH UNIT SUPPLIED BY AMF-S MAXIM DIVISION, AND WOULD DESALINIZE 10 MILLION GALLONS PER DAY WITH ABOUT 158,000 KWH/DAY OF ELECTRICITY. THE DUAL PURPOSE DESIGN IS AN OUTGROWTH OF AN AMF/UK-MITCHELL STUDY OF A BOILING-SUPERHEAT REACTOR FOR ITALY-S LARDERELLO COMPANY, WHICH WAS PROPOSED FOR USE IN COMBINATION WITH A GEOTHERMAL STEAM PLANT.

REFERENCES NUCLEONICS WEEK, MARCH 7, 1963, P. 3.
NEWS RELEASE.

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD09

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NAME/OWNER	VMR /VARIABLE MODERATOR REACTOR/AM=STANDARD	
DESIGNER	AMERICAN STANDARD CORP.	
LOCATION	CRITICAL ASSEMBLY AT ADVANCED TECHNOLOGY LABS, CALIFORNIA	
PURPOSE	POWER PROTOTYPE	
TYPE	BWR, VARIABLE MODERATOR, DIRECT CYCLE, FORCED CIRCULATION, CALANDRIA /SHELL-AND-TUBE/ CORE STRUCTURE.	
POWER MWE(MWT)	5-50	
CRITICAL	R AND D	
COOLANT	LIGHT WATER IN FUEL CHANNELS	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS, SINTERED AND GROUND, 0.320 IN. DIA.	
FUEL GEOMETRY	PINS, 0.353 IN. DIA., 50 IN. ACTIVE LENGTH	
FUEL CLADDING	ZIRCALOY OR 348 SS	
FUEL ENRICH.	2.2 PER CENT U-235	
FUEL ASSEMBLY	HEXAGONAL 37 RODS 181 ASSEMBLIES/CORE	
FUEL CHARGE	4590 KG. URANIUM DIOXIDE	
BURNUP(REFUEL)	15,000 MWD/TU	BATCH, 1/3 CORE PER YEAR
NEUTRON FLUX	THERMAL AVE. 3.1×10^{13}	
CONTROL	MODERATOR LEVEL ADJUSTMENT, OR MODERATOR LEVEL ADJUSTMENT AND SOLUTION POISON,	
COOLANT TEMP.	INLET 537 F	OUTLET 545 F
COOLANT PRESS.	1000 PSIA OPERATING STEAM PRESSURE	
REACTOR VESSEL	CYLINDRICAL A212-B STEEL, 304 SS CLAD, 6 FT. 4 IN. ID. / 14 FT. 6 IN. LONG.	
REMARKS	PROPOSAL HAS BEEN MADE BY WOLVERINE ELEC. COOP.,	

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BD09

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MICHIGAN, FOR A POWER PROTOTYPE BASED ON AMERICAN-STANDARD-S DESIGN STUDY OF VARIABLE MODERATOR REACTOR. A VMR IS UNDER STUDY AT BATTELLE MEMORIAL INSTITUTE, REACTOR CONCEPT PROPOSES AN ARRANGEMENT OF FUEL RODS IN CLUSTERS WHICH ARE SEPARATED FROM ONE ANOTHER BY RELATIVELY WIDE MODERATOR CHANNELS. THE COOLANT WATER IN THE CHANNELS IS SEPARATED FROM THE MODERATOR WATER OUTSIDE THE CLUSTERS BY A CALANDRIA DESIGN OF THE CORE STRUCTURE. LEVEL OF THE MODERATOR CAN BE ADJUSTED TO REGULATE AND CONTROL REACTIVITY.

REFERENCES

VARIABLE MODERATOR REACTOR DEVELOPMENT PROGRAM,
QUARTERLY PROGRESS REPORT NO. 1, AUGUST 31, 1959,
ATL-A-100 /1959/

HAZARDS SUMMARY REPORT FOR THE VMR CRITICAL
ASSEMBLY EXPERIMENTS.
RA EGEN, OTHERS
BMI-1445 /JUNE 10, 1960/

TECHNICAL FEASIBILITY AND ECONOMIC POTENTIAL OF
THE VARIABLE MODERATOR REACTOR, FINAL REPORT,
AMERICAN-STANDARD, ADV. TECHNOLOGY LABS,
ATL-A-109 /REV.1/ /DECEMBER 1960/

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BOILING LIGHT WATER REACTORS: DOMESTIC

BD10

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NAME/OWNER	BORAX-4 /BOILING REACTOR EXPERIMENT-4/AEC
DESIGNER	ARGONNE NATIONAL LABORATORY
OPERATOR	ARGONNE NATIONAL LABORATORY
LOCATION	NATIONAL REACTOR TEST STATION, IDAHO
PURPOSE	POWER EXPERIMENT
TYPE	BWR
POWER MWE(MWT)	2 20
CRITICAL	1957. CORE REVISION 1958
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM-THORIUM DIOXIDE PELLETS 0.225 IN. DIA. BORAX-3 USED URANIUM-ALUMINUM ALLOY FUEL
FUEL GEOMETRY	PLATE
FUEL CLADDING	ALUMINUM-NICKEL ALLOY
FUEL ENRICH.	7 PERCENT U-235 /BORAX-3 ENRICHMENT WAS 90 PERCENT/
FUEL ASSEMBLY	EXTRUDED ALLOY PLATES WITH 2 1/2 IN. DIA. TUBULAR CAVITIES CONTAINING FUEL PELLETS, THERMALLY BONDED TO CLADDING WITH LEAD. 6 PLATES/ASSEMBLY 69 ASSEMBLIES/CORE
NEUTRON FLUX	THERMAL AVE. 5×10^4
COOLANT TEMP.	400 F
COOLANT PRESS.	300 PSIG
REMARKS	EARLY BORAX EXPERIMENTS USED METALLIC FUEL TO INVESTIGATE BWR STABILITY.
REFERENCES	DESIGN AND OPERATING EXPERIENCE OF A PROTOTYPE BOILING WATER POWER REACTOR, JR DIETRICH, OTHERS PROC. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY 3, 56-60 /1958/

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD10

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OPERATIONAL EXPERIENCE WITH BORAX POWER PLANT.
 WH ZINN, OTHERS
 NUCLEAR SCI. AND ENG. 1. 420-37 /OCTOBER 1956/

PERFORMANCE EVALUATION OF DIRECT CYCLE BOILING
 WATER NUCLEAR POWER PLANTS BASED ON RECENT EBWR
 AND BORAX DATA,
 JM HARKER, OTHERS
 SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF
 ATOMIC ENERGY 9. 264-85 /1958/

CIVILIAN POWER REACTOR PROGRAM. PART III. STATUS
 REPORT ON THE BOILING WATER REACTOR TECHNOLOGY AS
 OF 1959.
 TID-8518 /5/ BOOK 5.

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD11

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NAME/OWNER	BORAX-5 /BOILING REACTOR EXPERIMENT-5//AEC
DESIGNER	ARGONNE NATIONAL LABORATORY
OPERATOR	ARGONNE NATIONAL LABORATORY
LOCATION	NATIONAL REACTOR TEST STATION, IDAHO
PURPOSE	POWER EXPERIMENT, NUCLEAR SUPERHEAT DEMONSTRATION.
TYPE	BWR, FORCED OR NATURAL CIRCULATION, DIRECT CYCLE, NUCLEAR SUPERHEAT.
POWER MWE(MWT)	2 20
CRITICAL	1962. DRY SUPERHEATED STEAM PRODUCED OCTOBER 1963.
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	BOILER, URANIUM DIOXIDE PELLETS 0.343 IN. DIA. SUPERHEATER, URANIUM DIOXIDE-SS CERMET
FUEL GEOMETRY	BOILER, RODS, 3/8 IN. DIA./24 IN. ACTIVE LENGTH SUPERHEATER, FLAT PLATE, 0.014 IN. THICK MEAT
FUEL CLADDING	BOILER, SS TUBES, WALL THICKNESS 0.015 IN. SUPERHEATER, SS CLADDING 0.008 IN. THICK
FUEL ENRICH.	BOILER, 10 PER CENT U-235 SUPERHEATER, 93 PER CENT U-235
FUEL ASSEMBLY	BOILER, 49 RODS, 7X7 SUPERHEATER, RIGID 4-PLATE ELEMENT 5 ELEMENTS/ASSEMBLY 12 ASSEMBLIES IN CENTRAL LOADING
NEUTRON FLUX	BOILER, 1.33X10 E+13 /AXIAL/, 1.45X10 E+13 /RADIAL/ SUPERHEATER 1.30X10 E+13 /AXIAL/
CONTROL	BORAL, SS-CLAD RODS.
REACTOR VESSEL	CYLINDRICAL, CARBON STEEL 66 3/8 IN. ID. /16 FT. HIGH, SS LINED
CONTAINMENT	PIT, SHIELDED BY HIGH DENSITY CONCRETE
REMARKS	STEAM IS SUPERHEATED IN TWO PASSES, FLOWING DOWN THROUGH FIRST-PASS ELEMENTS, THEN UPWARD THROUGH

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BOILING LIGHT WATER REACTORS, DOMESTIC

BD11

SECOND PASS. THREE SEPARATE CORE CONFIGURATIONS ARE POSSIBLE. BOILER-SUPERHEATER WITH CENTRAL SUPERHEAT, PURE BOILER, NO SUPERHEAT, AND BOILER WITH PERIPHERAL SUPERHEAT. DRY SUPERHEATED STEAM WAS PRODUCED IN OCTOBER 1963. THE REACTOR WILL BE PHASED OUT OF THE SUPERHEAT PROGRAM IN FISCAL 1965.

REFERENCES

PRELIMINARY DESIGN AND HAZARDS REPORT, BOILING REACTOR EXPERIMENT V /BORAX-V/
ARGONNE NATIONAL LABORATORY
ANL-6120 /FEBRUARY 1960/

A NUCLEAR SUPERHEATING REACTOR-BORAX-V,
V NOVICK, OTHERS
SMALL AND MEDIUM POWER REACTORS, VOL. 1, PP. 111-25
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1962

DESIGN AND HAZARDS SUMMARY REPORT, BOILING REACTOR EXPERIMENT V /BORAX-V/,
ARGONNE NATIONAL LABORATORY
ANL-6302 /MAY 1961/

BORAX-V INTEGRAL NUCLEAR SUPERHEAT REACTOR EXPERIMENTS,
WR WALLIN, OTHERS
POWER REACTOR EXPERIMENTS, VOL. 2 PP. 9-26
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1962

BORAX-V A NUCLEAR SUPERHEAT REACTOR,
RE RICE, WR WALLIN
AMERICAN POWER CONFERENCE 26TH ANNUAL MEETING,
CHICAGO, APRIL 1964. CONF-504-2

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BOILING LIGHT WATER REACTORS. DOMESTIC

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NAME/OWNER ALPR /ARGONNE LOW POWER REACTOR//AEC-ARMY
 DESIGNER ARGONNE NATIONAL LABORATORY
 OPERATOR COMBUSTION ENGINEERING, INC.
 LOCATION NATIONAL REACTOR TEST STATION, IDAHO
 PURPOSE PROTOTYPE PACKAGE POWER REACTOR
 TYPE BWR, NATURAL CIRCULATION, DIRECT CYCLE
 POWER MWE(MWT) 250 KWE 3
 CRITICAL 1958. DESTROYED BY EXPLOSION JANUARY 1961
 COOLANT LIGHT WATER
 MODERATOR LIGHT WATER
 FUEL MATERIAL URANIUM-ALUMINUM-NICKEL ALLOY
 FUEL GEOMETRY PLATE, 3 7/8 IN. BY 3 7/8 IN. BY 34 1/2 IN.
 FUEL CLADDING ALUMINUM-NICKEL ALLOY, 0.035 IN. THICK
 FUEL ENRICH. 91 PER CENT U-235
 FUEL ASSEMBLY 9 PLATES/ASSEMBLY
 40 ASSEMBLIES TO CORE
 FUEL CHARGE 14 KG. U-235 IN 40-ELEMENT CORE. 21 KG. U-235
 IN 60-ELEMENT CORE
 SPECIFIC POWER 214 KW/KG U-235 IN 40-ELEMENT CORE
 BURNUP(REFUEL) APPROX. 20 PER CENT 3 YEAR LIFE.
 IN 60-ELEMENT CORE.
 NEUTRON FLUX THERMAL AVE. 7.5×10^{12}
 FAST MAX. 3.28×10^{12}
 CONTROL BURNABLE POISON, BORON-10 IN ALUMINUM ATTACHED TO
 ASSEMBLY.
 9 CONTROL RODS
 COOLANT TEMP. INLET 175 F OUTLET 420 F
 COOLANT PRESS. 300 PSIG
 REACTOR VESSEL STEEL

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CONTAINMENT

CYLINDRICAL TANK-TYPE STRUCTURE, 38 FT. DIA./
48 FT. HIGH, GRAVEL SHIELDING FILL AROUND
PRESSURE VESSEL AND COMPONENTS.

REMARKS

OPERATION 1958, EXPLOSION ON JANUARY 3, 1961
DESTROYED CORE, RESULTING IN THREE FATALITIES.
REACTOR HAS BEEN DISMANTLED.

REFERENCES

DESIGN STUDY OF A NUCLEAR POWER PLANT FOR 100 KW
ELECTRIC AND 400 KW HEAT CAPACITY,
M TRESHOW, OTHERS
ANL-5452 /1957/

ARGONNE LOW POWER REACTOR. A PROTOTYPE DIRECT
CYCLE BOILING WATER REACTOR PACKAGE PLANT FOR
ELECTRIC POWER PRODUCTION AND SPACE HEATING.
CR BRAUN

SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY 9, 244-54 /1958/

ABWR PL-1 REFERENCE DESIGN REPORT,
FJ STARON, LM JOHNSON
CEND-70 /JANUARY 1960/

DESIGN OF THE ARGONNE LOW POWER REACTOR /ALPR/
NR GRANT, OTHERS
ANL-6076 /MAY 1961/

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BOILING LIGHT WATER REACTORS. DOMESTIC

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NAME/OWNER	EBWR/EXPERIMENTAL BOILING WATER REACTOR//AEC	
DESIGNER	ARGONNE NATIONAL LABORATORY	
OPERATOR	ARGONNE NATIONAL LABORATORY	
LOCATION	LEMONT, ILLINOIS	
PURPOSE	POWER EXPERIMENT	
TYPE	BWR, NATURAL CIRCULATION, DIRECT CYCLE	
POWER MWE(MWT)	5	20 100 MWT MODIFICATION IN 1962
CRITICAL	1956	SEE REMARKS
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	CORE 1, URANIUM-NIOBIUM-ZIRCONIUM ALLOY CORE 1A, URANIUM OXIDE IN ALUMINUM MATRIX SPIKE ELEMENTS URANIUM OXIDE IN ZIRCONIUM OR CALCIUM OXIDE MODIFICATION FOR PLUTONIUM-URANIUM OXIDE FUEL 1964	
FUEL GEOMETRY	CORE 1, PLATES, THICK AND THIN, 4 FT. ACTIVE LENGTH CORE 1A, FUELED ROD 5 FT. LONG AS SPIKE ELEMENTS	
FUEL CLADDING	CORE 1, ZIRCALOY -2 0.020 IN. THICK CORE 1A, ZIRCALOY-2,	
FUEL ENRICH.	CORE 1, 1.44 PER CENT U-235 CORE 1A, HIGH	
FUEL ASSEMBLY	CORE 1, 6-PLATE ELEMENTS 114 ASSEMBLIES/CORE CORE 1A, 49-ROD ASSEMBLY	
FUEL CHARGE	5600 KG. URANIUM /FIRST LOADING/	
SPECIFIC POWER	CORE 1, 270 KW/KG U-235	
NEUTRON FLUX	THERMAL AVE. /100 MWT/ 3×10^{13}	
CONTROL	MOVABLE RODS	
COOLANT TEMP.	INLET 130 F	OUTLET 489 F

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REACTOR VESSEL STEEL VESSEL 84 IN. ID., SS CLAD

CONTAINMENT CYLINDRICAL STEEL TANK 80 FT. DIA./119 FT. HIGH.

REMARKS ON NOVEMBER 15, 1962, THE EBWR REACHED 100 MWT. MODIFICATIONS INCLUDED ADDING 32 HIGHLY ENRICHED ELEMENTS TO THE CORE, ADDITION OF CONTROL RODS, APPROPRIATE PIPING AND VALVES. EBWR HAS BEEN SHUT DOWN AGAIN FOR FURTHER MODIFICATION LEADING TO FUELING WITH PLUTONIUM/URANIUM OXIDE. THE MIXED OXIDE FUEL WILL BE IN THE CENTER OF THE CORE, WITH ENRICHED URANIUM DIOXIDE ASSEMBLIES SURROUNDING IT. FIRST SELF-SUSTAINING ACTION WITH PLUTONIUM FUEL ACHIEVED IN SEPT. 1965, WITH ELECTRICITY GENERATION IN OCT. 1966. FULL POWER OF 42 MWT WAS REACHED NOV. 11, 1966.

REFERENCES THE EXPERIMENTAL BOILING WATER REACTOR /EBWR/
ANL-5607 /MAY 1957/

REACTORS ON-THE-LINE. EXPERIMENTAL BOILING
WATER REACTOR.
NUCLEONICS 15, 52A-53A /JULY 1957/

HAZARDS EVALUATION REPORT ASSOCIATED WITH THE
OPERATION OF EBWR AT 100 MW.
EA WIMUNC, JM HARRER
ANL-5781 /ADD/ /REV 1/ /OCTOBER, 1960/

MODIFICATION OF THE EXPERIMENTAL BOILING WATER
REACTOR /EBWR/ FOR HIGH-POWER OPERATION.
JF MATOUSEK, COMP.
ANL-6552 /APRIL 1962/

HAZARDS SUMMARY REPORT ON THE EXPERIMENTAL
BOILING WATER REACTOR /EBWR/
ANL-5781

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BOILING LIGHT WATER REACTORS, DOMESTIC

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NAME/OWNER PL /PORTABLE LOW-POWER//AEC-U.S. ARMY

DESIGNER COMBUSTION ENGINEERING, INC.

PURPOSE POWER AND HEAT

TYPE BWR, NATURAL CIRCULATION, DIRECT CYCLE

POWER MWE(MWT) 1 8.5

CRITICAL DESIGN

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL CLADDING SS TUBES

FUEL ENRICH. 4.8 PER CENT U-235

FUEL ASSEMBLY 59 FUEL ELEMENTS, 3 POISON ELEMENTS/ASSEMBLY
 24 ASSEMBLIES/CORE

REMARKS PL IS ONE OF SEVERAL REACTORS IN THE ARMY-S BWR
 PROGRAM PROPOSED FOR INSTALLATION IN A SNOW
 TUNNEL AT BYRD STATION, ANTARCTICA. THE CORE
 CONTAINS 24 FUEL ASSEMBLIES, EACH COMPOSED OF 59
 FUEL ELEMENTS AND THREE POISON ELEMENTS.

REFERENCES PL FINAL DESIGN REPORT, VOL. IV, REACTOR DESIGN,
 COMBUSTION ENGINEERING INC.
 CEND-135 /VOL. 4/ /1961/
 VOLUMES 1-5 ARE DATED JUNE 30, 1961.

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BOILING LIGHT WATER REACTORS, DOMESTIC

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NAME/OWNER VBWR/VALLECITOS BOILING WATER REACTOR//GE-PACIFIC
G + E

DESIGNER GENERAL ELECTRIC COMPANY

OPERATOR PACIFIC GAS + ELECTRIC CO.

LOCATION PLEASANTON, CALIF.

PURPOSE POWER PROTOTYPE

TYPE BWR, NATURAL CIRCULATION, DIRECT CYCLE.

POWER MWE(MWT) 5 20

CRITICAL 1957. MODIFICATIONS 1960, PERMANENTLY SHUT-DOWN
1963

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE-SS MATRIX

FUEL GEOMETRY PLATES, 2.950 IN. WIDE/37 IN. LONG,
SOME RODS.

FUEL CLADDING SS 0.005 IN. THICK

FUEL ENRICH. 90 PER CENT U-235

FUEL ASSEMBLY 6-9 PARALLEL PLATES/ASSEMBLY.
120 PLATES/CORE

FUEL CHARGE 25 KG. U-235

SPECIFIC POWER 1200 KW/KG U-235

NEUTRON FLUX THERMAL AVE. 4.5×10^{13}

CONTROL POISON PLATES, BORON-SS AND BORON CARBIDE

COOLANT TEMP. INLET. VARIES OUTLET, 546 F

COOLANT PRESS. INLET, 1000 PSIA

REACTOR VESSEL CARBON STEEL, SS CLAD, 7 FT. OD., 3 1/2 IN. THICK

CONTAINMENT PRESSURE-TIGHT, UPRIGHT CYLINDRICAL STEEL BUILDING
48 FT. DIA./100 FT. HIGH.

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REMARKS

TEST FACILITY FOR THE DRESDEN REACTOR, AND A
DEMONSTRATION PLANT. SUPERHEAT PROGRAMS WERE
INVESTIGATED. SEE VESR. SEE ALSO SADE,

REFERENCES

REACTORS ON-THE-LINE. VBWR.
NUCLEONICS 16, INSERT. /FEBRUARY 1958/

GENERAL ELECTRIC VALLECITOS BOILING WATER REACTOR.
FINAL HAZARDS SUMMARY REPORT.
JLI MURRAY, ED.
SG-VAL-2 /3RD ED/ /NOVEMBER 30, 1959/

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BOILING LIGHT WATER REACTORS. DOMESTIC

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NAME/OWNER DRESDEN-1/COMMONWEALTH EDISON

DESIGNER GENERAL ELECTRIC COMPANY

OPERATOR COMMONWEALTH EDISON

LOCATION MORRIS, ILLINOIS

PURPOSE POWER

TYPE BWR, FORCED CIRCULATION, DUAL CYCLE

POWER MWE(MWT) 200 700

CRITICAL 1960
REFUELING NOV. 1962 AND APRIL 1964

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS 0.498 IN. DIA./0.625 IN. LONG.

FUEL GEOMETRY ROD, 1/2 IN. DIA./106.5 IN. ACTIVE LENGTH
FUEL ROD CONSISTS OF 4 FUEL SEGMENTS JOINED
END-TO-END, WITH SPACER PLATES BETWEEN THE
SEGMENTS.

FUEL CLADDING ZIRCALOY-2, 0.030 IN. THICK

FUEL ENRICH. 1.5 PER CENT U-235

FUEL ASSEMBLY SQUARE CHANNEL, 36 RODS, 6X6,
488 ASSEMBLIES/CORE

FUEL CHARGE 51,500 KG.URANIUM

SPECIFIC POWER 11.50 MW/MTU

BURNUP(REFUEL) 10,000 MWD/TON BATCH REFUELING 10-30 PERCENT

NEUTRON FLUX THERMAL AVE. 3.15×10^{13}
FAST /TYPICAL/ 1×10^{14}

CONTROL MOVABLE POISON RODS, CADMIUM-SILVER ALLOY, SS CLAD

COOLANT TEMP. INLET 504.7 F OUTLET 546.4 F

COOLANT PRESS. INLET 1027.7 PSIG

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REACTOR VESSEL CARBON STEEL, SS CLAD, 12 FT. 2 IN. ID.

CONTAINMENT STEEL SPHERE, 190 FT. DIA., ABOVE-GRADE INSULATED.

REMARKS SUBCOOLED WATER ENTERS AT THE BOTTOM OF THE REACTOR VESSEL AND FLOWS UPWARD THROUGH THE ASSEMBLIES, WHERE IT BOILS. THE STEAM-WATER MIXTURE FLOWS OUT AT THE TOP OF THE FUEL ASSEMBLIES AND IS DIRECTED TO THE REACTOR VESSEL OUTLET NOZZLES. EXTERNAL LOOPS HANDLE RECIRCULATION FLOW, THERE BEING NO RECIRCULATION OF THE CORE COOLANT WITHIN THE REACTOR VESSEL.

REFERENCES PRELIMINARY HAZARDS SUMMARY REPORT FOR THE DRESDEN NUCLEAR POWER STATION.

G SEGE

GEAP=1044 /MAY 1, 1957

PRELIMINARY HAZARDS SUMMARY REPORT FOR THE DRESDEN NUCLEAR POWER STATION.

AMENDMENT NO. 1

GEAP=3009 /MAY 1, 1958/

AMENDMENT NO. 2 /DP EBRIGHT/

GEAP=3053 /AUGUST 22, 1958/

AMENDMENT NO. 3 /JL MURRAY, DP EBRIGHT/

GEAP=3076 /DECEMBER 23, 1958/

AMENDMENT NO. 4, PART I /DP EBRIGHT/

GEAP=3106 /FEBRUARY 1959/

AMENDMENT NO. 6 /DP EBRIGHT/

GEAP=3186 /JUNE 12, 1959/

DRESDEN ON-THE-LINE.

NUCLEONICS 17, INSERT. /DECEMBER 1959/

PERFORMANCE AND OPERATING EXPERIENCE OF THE DRESDEN NUCLEAR POWER STATION.

IL WADE

ASME PREPRINT 61-WA-268 /1961/

THE DRESDEN NUCLEAR POWER STATION.

POWER REACTOR TECHNOLOGY 4/4/, 56-68 /SEPT. 1961/

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NAME/OWNER	DRESDEN-2/COMMONWEALTH EDISON	
DESIGNER	GENERAL ELECTRIC COMPANY	
OPERATOR	COMMONWEALTH EDISON	
LOCATION	MORRIS, ILLINOIS	
PURPOSE	POWER	
TYPE	BWR, SINGLE CYCLE, FORCED CIRCULATION /2-LOOP/, INTERNAL STEAM SEPARATION.	
POWER MWE(MWT)	715	2300
CRITICAL:	CONTRACT AWARD FOR DRESDEN-2 AND -3, TARGET 1970. REFERENCE DESIGN	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.488 IN. DIA. /0.75 IN. LONG	
FUEL GEOMETRY	ROD 144 IN. ACTIVE LENGTH	
FUEL CLADDING	ZIRCALOY-2 TUBES 0.036 IN. WALL THICKNESS	
FUEL ENRICH.	AVERAGE 2 PER CENT U-235	
FUEL ASSEMBLY	49-ROD BUNDLE 7X7. APPROX. 14 RODS HAVE REDUCED ENRICHMENT. ASSEMBLY ENCLOSED IN ZIRCALOY CHANNEL 724 ASSEMBLIES	
BURNUP(REFUEL)	AVERAGE INITIAL 15000 MWD/T	ANNUAL: PROGRESSIVE PARTIAL BATCH
CONTROL	CRUCIFORM CONTROL BLADES, BORON CARBIDE POWDER IN SS TUBES TEMPORARY BORON-SS POISON CURTAINS	
COOLANT TEMP.	INLET 530.4 F	
COOLANT PRESS.	1000 PSIG	
REACTOR VESSEL	ALLOY STEEL CYLINDER 6 1/8 IN. THICK, INNER SS CLADDING 7/32 IN. THICK	
CONTAINMENT	PRESSURE-SUPPRESSION, CORE SPRAY SYSTEM.	

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REMARKS

TOTAL CAPACITY OF THE DRESDEN NUCLEAR STATION
WILL BE 1800 MWE

REFERENCES

DRESDEN NUCLEAR POWER STATION UNIT 2
PLANT DESIGN AND ANALYSIS REPORT
NP#15538 /ND/ VOL. 1-2-3

NUCLEONICS WEEK JAN. 27, 1966 P.1
NEWS RELEASE

AEC NEWS RELEASE J-200
AUG, 25, 1966

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NAME/OWNER FITCHBURG GAS AND ELECTRIC PLANT/FITCHBURG G+E,
 FITCHBURG PAPER CO

DESIGNER GENERAL ELECTRIC COMPANY

LOCATION MASSACHUSETTS

PURPOSE POWER AND PROCESS HEAT

TYPE BWR, NATURAL CIRCULATION

POWER MWE(MWT) 28

CRITICAL PROPOSAL, SEE REMARKS.

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

CONTAINMENT PRESSURE-SUPPRESSION

REMARKS PLANT WOULD SUPPLY AN AVERAGE OF 140,000 POUNDS
 OF STEAM PER DAY FOR PROCESS HEAT. GE-S DECISION
 TO BUILD NO NUCLEAR STATIONS UNDER 50 MWE WILL
 CAUSE FITCHBURG G+E TO RE-EVALUATE ITS PROPOSAL.

REFERENCES FORUM MEMO SEPT, 1963 P, 16
 NEWS RELEASE.

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B019

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NAME/OWNER	GOLDEN VALLEY REACTOR/GOLDEN VALLEY ELEC. ASSOC.
DESIGNER	GENERAL ELECTRIC COMPANY
OPERATOR	GOLDEN VALLEY ASSOCIATION OF FAIRBANKS
LOCATION	ALASKA
PURPOSE	POWER
TYPE	BWR
POWER MWE(MWT)	22
CRITICAL	PROPOSAL
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
REFERENCES	FORUM MEMO SEPT, 1963 P. 16 NEWS RELEASE.

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NAME/OWNER BIG ROCK POINT STATION/CONSUMERS POWER CO.
 DESIGNER GENERAL ELECTRIC COMPANY
 OPERATOR CONSUMERS POWER COMPANY
 LOCATION CHARLEVOIX, MICH.
 PURPOSE POWER, PRODUCTION OF COBALT-60
 TYPE BWR, FORCED CIRCULATION, DIRECT CYCLE, HIGH
 POWER DENSITY
 POWER MWE(MWT) 71 240 /SEE REMARKS/
 CRITICAL SEPT. 1962.
 REFUELED MAY 1966
 COOLANT LIGHT WATER
 MODERATOR LIGHT WATER
 FUEL MATERIAL URANIUM DIOXIDE PELLETS, 0.345 IN. DIA./0.019 IN.
 THICK
 FUEL GEOMETRY RODS /STACK OF CYL. PELLETS/, APPROX. 70 IN.
 ACTIVE LENGTH
 FUEL CLADDING SS TUBES, 0.043 IN. THICK
 CORE 2, ZIRCALOY-CLAD ELEMENTS WILL REPLACE
 THE SS-CLAD ELEMENTS REMOVED
 FUEL ENRICH. 3.2 PER CENT U-235
 FUEL ASSEMBLY 144 RODS/ASSEMBLY, 12X12
 56 ASSEMBLIES/CORE
 SEE REMARKS
 FUEL CHARGE 11,700 KG. URANIUM
 BURNUP(REFUEL) 10,000 MWD/TON U
 CONTROL CONTROL RODS CONTAINING BORON CARBIDE, CENTRAL AND
 PERIPHERAL BOTTOM-ENTERING, POISON CURTAIN
 BORATED SS, LIQUID POISON INJECTION.
 COOLANT TEMP. INLET 346 F
 COOLANT PRESS. 1050 PSIA
 REACTOR VESSEL CARBON STEEL, SS-CLAD, 30 FT. HIGH/106 IN. ID.

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CONTAINMENT

SPHERE, 130 FT. DIA., 103 FT. ABOVE-GRADE,
EXTERNAL INSULATION OF CORK MASTIC COATING
PROTECTED BY ACRYLIC RESIN.

REMARKS

THE ASSEMBLY HAS 12 SMALLER DIA. FUEL RODS, 3 TO
EACH CORNER, TO REDUCE POWER PEAKING. IN PHASE II
OF THE R+D PROGRAM THE CORE SIZE WILL BE
INCREASED TO 86 BUNDLES. PLANNED STEP-WISE
APPROACH TO 240 MWT IS INDICATED.
DEVELOPMENTAL FUEL BUNDLES WITH CLADDINGS OF
ZIRCALOY-2, INCONEL, AND INCOLOY WILL BE INSERTED
INTO THE CORE. THE COOLANT FLOW IS UPWARD FROM
INLET DIFFUSERS, THROUGH OPENINGS IN THE GUIDE
TUBE SUPPORT, AND THROUGH THE FUEL CHANNELS.
THE FIRST COBALT INSERTION FOR LARGE-SCALE
COMMERCIAL PRODUCTION OF COBALT-60 WILL BE MADE
DURING MAY 1966 REFUELING.

REFERENCES

NEW BOILING WATER NUCLEAR PLANT /BIG ROCK POINT,
MICHIGAN/
MECH. ENG. 81, 80 /OCTOBER 1959/

FINAL HAZARDS SUMMARY REPORT FOR BIG ROCK POINT
PLANT.
VOLUME I. PLANT TECHNICAL DESCRIPTION AND
SAFEGUARD EVALUATION.
CONSUMERS POWER CO.
NP-11153 /VOL. I/ /NOVEMBER 1961/

HIGH POWER DENSITY DEVELOPMENT PROJECT, INTERIM
REPORT, 300 MW/E/ HPD CONCEPTUAL DESIGN STUDY.
GEAP-3967 /JUNE 22, 1962/

DESIGN PRACTICE. HUMBOLDT BAY AND BIG ROCK POINT.
W MITCHELL
POWER REACTOR TECHNOLOGY 7/1/, 70-84 /WINTER 1963
1964/

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BOILING LIGHT WATER REACTORS, DOMESTIC

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NAME/OWNER HUMBOLDT BAY PLANT/PACIFIC G+E
DESIGNER GENERAL ELECTRIC COMPANY
OPERATOR PACIFIC GAS + ELECTRIC CO.
LOCATION EUREKA, CALIF.
PURPOSE POWER
TYPE BWR, NATURAL CIRCULATION, SINGLE CYCLE
POWER MWE(MWT) 51.2 165
CORE 3, 67.5 MWE
CRITICAL FEB. 1963
COOLANT LIGHT WATER
MODERATOR LIGHT WATER
FUEL MATERIAL URANIUM DIOXIDE PELLETS 0.420 IN. DIA./0.6 IN.
LONG, SINTERED SOLID CYLINDRICAL
FUEL GEOMETRY RODS, 79 IN. ACTIVE LENGTH
FUEL CLADDING SS.
SEE REMARKS
FUEL ENRICH. 2.6 PER CENT U-235
FUEL ASSEMBLY 49 RODS, 7x7
172 BUNDLES/CORE
FUEL CHARGE 13,840 KG. U /34,600 POUNDS URANIUM DIOXIDE/
BURNUP(REFUEL) 10,000 MWD/TU BATCH, APPROX. 20 PER CENT
NEUTRON FLUX THERMAL AVE, 2X10 E+13
THERMAL MAX, 4X10 E+13
FAST AVE, 5X10 E+13
CONTROL MOVABLE RODS CONTAINING BORON CARBIDE, BOTTOM
DRIVEN AND PERIPHERAL. POISON CURTAIN BORATED SS,
LIQUID POISON INJECTION.
COOLANT PRESS. 1035 PSIA
REACTOR VESSEL CARBON STEEL, SS CLAD, 42 FT. HIGH/120 IN. ID.
CONTAINMENT PRESSURE-SUPPRESSION /DRY-WELL, SUPPRESSION

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CHAMBER AND POOL/.

REMARKS

AFTER 6 MONTHS OPERATION, ONE-THIRD OF THE
SS CHANNELS IN THE CORE WILL BE REPLACED WITH
ZIRCALOY-2. EVENTUALLY ALL SS WILL BE REPLACED.
COOLANT FLOW IS UPWARD FROM THE BOTTOM OF THE
CORE.

REFERENCES

PRELIMINARY HAZARDS SUMMARY REPORT.
HUMBOLDT BAY POWER PLANT UNIT NO. 3.
PACIFIC GAS + ELECTRIC CO.
NP-7512 /APRIL 15, 1959/

PACIFIC GAS + ELECTRIC COMPANY FINAL HAZARDS
SUMMARY REPORT, HUMBOLDT BAY POWER PLANT UNIT
NO. 3.
PACIFIC GAS + ELECTRIC CO.
NP-14319 /SEPT, 1, 1961/

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BOILING LIGHT WATER REACTORS, DOMESTIC

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NAME/OWNER	BODEGA BAY ATOMIC PLANT/PACIFIC G+E
DESIGNER	GENERAL ELECTRIC COMPANY
OPERATOR	PACIFIC GAS + ELECTRIC CO.
LOCATION	BODEGA BAY, SONOMA COUNTY, CALIF.
TYPE	BWR, FORCED CIRCULATION, DIRECT CYCLE.
POWER MWE(MWT)	313 1000
CRITICAL	PROJECT HAS BEEN CANCELED.
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS
FUEL GEOMETRY	RODS
FUEL CLADDING	SS
FUEL ENRICH.	2.7 PER CENT U-235
FUEL ASSEMBLY	49 RODS, 7X7 29 ASSEMBLIES / CORE
FUEL CHARGE	67,000 KG. URANIUM
BURNUP(REFUEL)	15,000 MWD/TON U
CONTAINMENT	PRESSURE-SUPPRESSION, REINFORCED CONCRETE BUILDING
REMARKS	THE PROJECT HAS BEEN CANCELED BECAUSE OF SITING PROBLEMS.
REFERENCES	NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED AS OF JUNE 30, 1962. U. S. ATOMIC ENERGY COMMISSION TID-8200 /6TH REVISION/ /1962/ BODEGA BAY ATOMIC PARK, UNIT NUMBER 1, EXHIBIT C, PRELIMINARY HAZARDS SUMMARY REPORT, DECEMBER 28, 1962. PACIFIC GAS AND ELECTRIC CO. NP-12476 /1962/

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BOILING LIGHT WATER REACTORS, DOMESTIC

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NAME/OWNER	NIAGARA MOHAWK NUCLEAR PLANT /NINE MILE POINT/ NIAGARA MOHAWK POWER CORP.	
DESIGNER	GENERAL ELECTRIC COMPANY	
OPERATOR	NIAGARA MOHAWK POWER CORPORATION	
LOCATION	OSWEGO, NEW YORK /NINE MILE POINT/	
PURPOSE	POWER	
TYPE	BWR, FORCED CIRCULATION, SINGLE CYCLE	
POWER MWE(MWT)	525	1538
CRITICAL	TARGET AUGUST 1967, POWER OPERATION FEB. 1968	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	RODS	
FUEL CLADDING	ZIRCALOY-2 TUBES 0.5 IN. OD, WALL THICKNESS 0.03	
FUEL ENRICH.	2.1 PER CENT U-235	
FUEL ASSEMBLY	64-ROD ASSEMBLY 8X8 500 ASSEMBLIES/CORE	
FUEL CHARGE	95,400 KG. URANIUM	
BURNUP(REFUEL)	15000 MWD/T	BATCH, 20 PER CENT FIRST FUEL DISCHARGE SCHEDULED FOR JUNE 1969
CONTROL	BORON CARBIDE POWDER IN SS TUBES VARIABLE COOLANT RECIRCULATION FLOW.	
COOLANT TEMP.	INLET 530 F	
COOLANT PRESS.	INLET 1015 PSIA	
REACTOR VESSEL	CYLINDRICAL STEEL VESSEL, HEMISPHERICAL HEADS 17 FT. 9 IN. ID/61 FT. 2 IN. HIGH BETWEEN HEADS WALL THICKNESS 7 IN. SS INNER CLADDING 1/4 IN. THICK	
CONTAINMENT	PRESSURE-SUPPRESSION STRUCTURE CONSISTING OF A	

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DRYWELL CONTAINING THE REACTOR VESSEL AND FIVE
RECIRCULATION LOOPS, AND SUPPRESSION POOL,
REACTOR BUILDING IS REINFORCED CONCRETE HIGH-BAY
STRUCTURE.

REMARKS

CONTRACT FOR DESIGN AND CONSTRUCTION OF THE
REACTOR, TURBINE GENERATOR AND RELATED EQUIPMENT
AWARDED TO GE IN OCTOBER 1963.

REFERENCES

PRELIMINARY HAZARDS SUMMARY REPORT, NINE MILE
POINT NUCLEAR STATION, VOLS. I AND II, NIAGARA
MOHAWK POWER CORP. APRIL 1964. DOCKET 50-220.
/APRIL 1964/

FIRST SUPPLEMENT TO PRELIMINARY HAZARDS SUMMARY
REPORT, NINE MILE POINT NUCLEAR STATION, NIAGARA
MOHAWK POWER CORP. AUG. 1964 /EXHIBIT D, SUPP-1/

HAZARDS ANALYSIS BY THE DIVISION OF REACTOR
LICENSING IN THE MATTER OF NIAGARA MOHAWK POWER
CORPORATION 9-MILE POINT NUCLEAR STATION, OSWEGO
DIV. REACTOR LICENSING, AEC
TID-22438 /ND/

NINE MILE POINT NUCLEAR STATION,
PRELIMINARY HAZARDS SUMMARY REPORT
VOL. 1, 2, SUPPLEMENT 1
NIAGARA MOHAWK POWER CORP.
NP-15660

VOL.1, APRIL 1964

VOL.2, APRIL 1964

SUPPL. 1, AUG. 1964

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NAME/OWNER OYSTER CREEK NUCLEAR PLANT/JERSEY CENTRAL P + L

DESIGNER GENERAL ELECTRIC COMPANY

OPERATOR JERSEY CENTRAL POWER AND LIGHT CO.

LOCATION OYSTER CREEK, N. J.

PURPOSE POWER

TYPE BWR DIRECT CYCLE, FORCED CIRCULATION

POWER MWE(MWT) 515 1600

CRITICAL TARGET 1967

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL GEOMETRY ROD ACTIVE LENGTH 144 IN.

FUEL CLADDING ZIRCALOY-2 TUBES 0.502 IN. OD/0.034 IN. THICK

FUEL ENRICH. 2.1 PER CENT U-235

FUEL ASSEMBLY 49-ROD BUNDLE, ZIRCALOY OUTER CHANNEL
532 ASSEMBLIES/CORE

FUEL CHARGE 486 POUNDS URANIUM DIOXIDE/ASSEMBLY

BURNUP(REFUEL) 15000 MWD/T PARTIAL BATCH
25 PER CENT, SCATTER PATTERNCONTROL CRUCIFORM BLADES, BORON CARBIDE POWDER IN SS
BORON-SS POISON CURTAINS

COOLANT TEMP. 301 F

COOLANT PRESS. 1000 PSI

REACTOR VESSEL STEEL CYLINDER 17 FT. 9 IN. ID/61 FT. 2 IN,
BETWEEN HEADS. CYLINDER CONTAINS CORE, STEAM
SEPARATORS AND DRIERS.CONTAINMENT PRESSURE-SUPPRESSION SYSTEM CONSISTING OF DRYWELL
AND PRESSURE-ABSORPTION STRUCTURE. DRYWELL
ENCLOSES REACTOR VESSEL, PUMPS, PIPING, CONTROL

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ROD DRIVES,
ABSORPTION CHAMBER IS A TOROIDAL STEEL SHELL
ENCLOSED IN REINFORCED CONCRETE VAULT, OUTSIDE OF
AND BELOW DRYWELL AND PARTIALLY FILLED WITH WATER.
CONTAINMENT STRUCTURE IS REINFORCED CONCRETE,
PARTIALLY BELOW-GRADE.

REFERENCES

APPLICATION TO U. S. ATOMIC ENERGY COMMISSION FOR
REACTOR CONSTRUCTION PERMIT AND OPERATING
LICENCES, OYSTER CREEK NUCLEAR POWER PLANT UNIT
PART 9, PRELIMINARY SAFEGUARDS SUMMARY REPORT,
MARCH 1964,
JERSEY CENTRAL POWER + LIGHT CO.
DOCKET 50-219
NP-14365 /ND/

OYSTER CREEK
NUCLEAR ENG. 10, 225-28 /JUNE 1965/

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BOILING LIGHT WATER REACTORS. DOMESTIC

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NAME/OWNER	BONUS /BOILING NUCLEAR SUPERHEAT//AEC, PRWRA
DESIGNER	GENERAL NUCLEAR ENGINEERING CORPORATION
OPERATOR	PUERTO RICO WATER RESOURCES AUTHORITY
LOCATION	PUNTA HIGUERA, PUERTO RICO
PURPOSE	POWER DEMONSTRATION
TYPE	BWR, FORCED CIRCULATION, NUCLEAR SUPERHEAT PRESSURE TUBE
POWER MWE(MWT)	16.5 50
CRITICAL	APRIL 1964
COOLANT	LIGHT WATER AND STEAM.
MODERATOR	LIGHT WATER REFLECTOR, LIGHT WATER
FUEL MATERIAL	CENTRAL BOILER, URANIUM DIOXIDE PELLETS 0.445 IN. DIA. SUPERHEATER, URANIUM DIOXIDE PELLETS 0.5 IN. DIA.
FUEL GEOMETRY	BOILER, SEGMENTED ROD 0.50 IN. OD., 54 IN. ACTIVE LENGTH SUPERHEATER, ROD 54.6 IN. ACTIVE LENGTH
FUEL CLADDING	BOILER, ZIRCALOY-2 TUBES 0.025 IN. WALL THICKNESS SUPERHEATER INCONEL 0.018 IN. THICK
FUEL ENRICH.	BOILER, 2.4 PER CENT U-235 WITH NATURAL U IN 4 CENTRAL ELEMENTS SUPERHEAT, 3.25 PER CENT U-235
FUEL ASSEMBLY	BOILER, 32 TUBES, 64 ASSEMBLIES. SUPERHEAT, 32 RODS, 32 ASSEMBLIES IN PRESSURE TUBES
FUEL CHARGE	BOILER, 2.81 TONS U SUPERHEAT, 1.79 TONS U
SPECIFIC POWER	BOILER, 13.2 TMW/TON U SUPERHEAT, 7.25 TMW/TON U
BURNUP(REFUEL)	BOILER, 12,900 MWD/MTU SUPERHEATER, 13,000 MWD/MTU

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CONTROL BORON-SS RODS, GRAVITY SCRAM, CRUCIFORM RODS IN
BOILER SECTION AND SLAB RODS BETWEEN BOILER-
SUPERHEATER, PLUS CHEMICAL SHIM,

COOLANT TEMP. BOILER 540 F
SUPERHEAT 900 F

COOLANT PRESS. 950 PSIG

REACTOR VESSEL CARBON STEEL CYLINDER 7 FT. ID./26 FT. 6 IN. HIGH
AVERAGE THICKNESS 3 1/8 IN.
INNER SS CLADDING 1/4 IN. THICK

CONTAINMENT HEMISPHERICAL STEEL SHELL WELDED TO CYLINDRICAL
STEEL WALL, LOW-PRESSURE, HOUSES THE ENTIRE PLANT,
CYLINDRICAL CONCRETE OUTER WALL. BUILDING IS 107
FT. ABOVE GROUND.

REMARKS HEMISPHERICAL STEEL SHELL 166 FT. 8 IN. DIA.,
13/32 IN. THICK, CONCRETE MAT, HOUSES ENTIRE
PLANT, LOW-PRESSURE DESIGN, 5 PSIG INTERNAL
PRESSURE,
ASSEMBLIES ARE ARRANGED IN FOUR GROUPS AROUND
THE SQUARE BOILER ZONE. THE FUEL ROD IS
SURROUNDED BY A STAINLESS STEEL TUBE TO FORM
THE STEAM COOLANT ANNULUS, AND THIS IS SURROUNDED
BY A STAINLESS STEEL PRESSURE TUBE TO PROVIDE A
THERMAL INSULATING GAP BETWEEN THE COOLANT TUBE
AND THE WATER MODERATOR. DESIGN HAS BEEN
EXTRAPOLATED TO A LARGE CENTRAL STATION INTEGRAL
NUCLEAR SUPERHEAT STEAM PLANT. GNEC IS DESIGNING
AN ANNULAR SUPERHEAT ELEMENT TO REPLACE THE
TUBULAR ELEMENTS OF THE FIRST CORE LOADING.

REFERENCES BOILING NUCLEAR SUPERHEATER /BONUS/ POWER STATION.
PRELIMINARY DESIGN STUDY AND HAZARDS SUMMARY
REPORT, VOL. II. REFERENCE DESIGN, VOL. III.
ALTERNATE DESIGN STUDIES, VOL. IV. PRELIMINARY
HAZARDS SUMMARY REPORT,
PRWRA, GENERAL NUCLEAR ENG.
TID-8524 /JUNE 1960/

NUCLEAR SUPERHEAT. THE BONUS REACTOR,
POWER REACTOR TECHNOLOGY 3, 68-74 /SEPTEMBER 1960/

BOILING NUCLEAR SUPERHEATER /BONUS/ POWER STATION
TECHNICAL SPECIFICATIONS,
F BEVILACQUA
GNEC-214 /OCTOBER 26, 1962/

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BOILING NUCLEAR SUPERHEATER /BONUS/ POWER STATION.
SUPPLEMENTARY STUDY. EXTRAPOLATION TO LARGE
CENTRAL STATION INTEGRAL NUCLEAR SUPERHEAT PLANT.
GENERAL NUCLEAR ENG.
PRWRA-GNEC-4 /ND/

BOILING NUCLEAR SUPERHEATER /BONUS/ POWER STATION.
FINAL SUMMARY DESIGN REPORT.
PRWRA, GENERAL NUCLEAR ENG.
PRWRA-GNEC-6 /FEB. 1, 1962/

BOILING NUCLEAR SUPERHEATER /BONUS/ POWER STATION.
FINAL HAZARD SUMMARY REPORT.
PRWRA, GENERAL NUCLEAR ENG.
PRWRA-GNEC-5 /FEB. 1, 1962/

DESIGN AND CONSTRUCTION PRACTICE. BONUS.
POWER REACTOR TECHNOLOGY 7/3/. 292-312
/SUMMER 1964/

BOILING NUCLEAR SUPERHEATER /BONUS/ POWER STATION
PUNTA HIGUERA SITE NEAR RINCON, PUERTO RICO
PROJECT COMPLETION REPORT
OAK RIDGE OPERATIONS OFFICE
ORO-649 /JUNE 1966/

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NAME/OWNER	NUSU /NUCLEAR SUPERHEAT/
DESIGNER	GENERAL NUCLEAR ENG. CORP., COMBUSTION ENG,
PURPOSE	POWER
TYPE	BWR, DIRECT CYCLE, FORCED CIRCULATION, NUCLEAR SUPERHEAT
POWER MWE(MWT)	200 633
CRITICAL	DESIGN
COOLANT	LIGHT WATER AND STEAM
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS, ANNULAR, 1.114 IN. DIA./ 0.20 IN. THICK
FUEL GEOMETRY	BOILER, ANNULAR RODS SUPERHEATER, DOUBLE-ANNULAR RODS
FUEL CLADDING	BOILER, SS INNER AND OUTER, 0.020 IN. THICK SUPERHEATER, OUTER SS, INTERMEDIATE HASTELOY X, INNER HASTELOY X
FUEL ENRICH.	BOILER, 4.5 PER CENT U-235 SUPERHEATER 2.4 PER CENT U-235
FUEL ASSEMBLY	BOILER, 42-ROD ASSEMBLY, HEXAGONAL- 30 ASSEMBLIES/CORE SUPERHEATER, 18-ROD ASSEMBLY, HEXAGONAL 61 ASSEMBLIES/CORE
FUEL CHARGE	32.5 SHORT TONS URANIUM
SPECIFIC POWER	16.4 MW/T URANIUM
BURNUP(REFUEL)	BATCH, 1/3 CORE
CONTROL	BORON-SS RODS
REACTOR VESSEL	CARBON STEEL CYLINDER, HEMISPHERICAL HEADS, 11 FT, 6 IN. ID. AND 15 FT. 2 IN. HIGH, SS INNER CLADDING
CONTAINMENT	CYLINDRICAL CONCRETE STRUCTURE, HEMISPHERICAL STEEL DOME, CARBON STEEL SHELL. PRESSURE-SUPPRESSION SYSTEM.
REMARKS	DESIGN STUDY OF AN INTEGRAL BOILING-SUPERHEATING

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DESIGN WITH A TWO-REGION CORE. BOTH BOILING AND SUPERHEATING OCCUR IN THE SUPERHEAT REGION, WHICH IS FUELED WITH DOUBLE ANNULAR FUEL ELEMENTS. STEAM IS SUPERHEATED ON THE INTERNAL SURFACES OF THE ELEMENT, AND BOILING OCCURS ON THE EXTERNAL SURFACE WHICH IS IN CONTACT WITH THE LIQUID COOLANT WATER. SURROUNDING BOILER REGION IS FUELED WITH SINGLE-ANNULAR ELEMENTS. BOILING OCCURS ON BOTH INNER AND OUTER SURFACES. LIQUID COOLANT FLOW IS TWO-PASS, THE BOILER SECTION AND THE BOILER PART OF THE SUPERHEAT SECTION BEING HYDRAULICALLY IN SERIES.

REFERENCES

DIRECT CYCLE BOILING WATER REACTOR WITH INTEGRAL NUCLEAR SUPERHEAT.
GENERAL NUCLEAR ENGINEERING CORP.
GNEC-212 /JAN. 1962/

A 200 MWE BOILER-SUPERHEATER REACTOR,
PRELIMINARY DESIGN.
GENERAL NUCLEAR ENG.
GNEC-136 /OCT. 1960/

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NAME/OWNER BOSTON EDISON REACTOR/BOSTON-ED.

DESIGNER GENERAL ELECTRIC COMPANY

LOCATION SITE HAS NOT BEEN IDENTIFIED.

TYPE BWR

POWER MWE(MWT) 612 1682

CRITICAL PLANNED
CONSTRUCTION 1967. TARGET 1971CONTAINMENT DOUBLE PRESSURE-SUPPRESSION SYSTEM, WHICH INCLUDES
A DRYWELL AND PRESSURE-SUPPRESSION CHAMBER, PLUS
A SECOND UNDERGROUND CHAMBER AND POOL SURROUNDING
THE REACTOR BUILDING, TO WHICH THE LATTER IS
VENTED, THE SECOND CHAMBER IS VENTED TO THE STACK.

REMARKS TYPE SELECTION IN FEBRUARY 1965.

REFERENCES NUCLEONICS WEEK FEB, 25, 1965 P, 5
NEWS RELEASENUCLEAR INDUSTRY JAN, 1966 P, 9-10
NEWS RELEASENUCLEONICS WEEK APRIL 28, 1966 P.2
NEWS RELEASE

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NAME/OWNER SURFSIDE/ASDA, N.Y.
SMALL UNIFIED REACTOR FACILITY WITH SYSTEMS
FOR ISOTOPES, DESALTING, ELECTRICITY

OPERATOR ATOMIC AND SPACE DEV. AUTHORITY

LOCATION LONG ISLAND SOUND, NEW YORK

PURPOSE POWER, DESALINATION, ISOTOPE PRODUCTION,

TYPE BWR, PRESSURE TUBE

POWER MWE(MWT) 2.5 33

CRITICAL CONSTRUCTION 1966, TARGET 1968

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL GEOMETRY RODS

FUEL CLADDING ZIRCALOY TUBE 27 IN. LONG/0.440 IN. DIA.

FUEL ENRICH. 4-5 PER CENT U-235

FUEL ASSEMBLY 37-TUBE BUNDLE,
82 ELEMENTS WILL BE CONTAINED IN THE
ZIRCALOY PRESSURE TUBES, EITHER SINGLY OR IN
CLUSTERS. TARGET MATERIALS CAN BE INSERTED
INDEPENDENT OF THE REFUELING.

REMARKS ASDA WILL PROCEED WITH CONSTRUCTION DESPITE NO
FEDERAL ASSISTANCE FROM EITHER AEC OR OSW.
LAND HAS BEEN SET ASIDE FOR A POSSIBLE ISOTOPE
PACKAGING PLANT ON-SITE. ESTIMATED FRESH WATER
PRODUCTION IS 5 MGD, WITH REDUCED POWER OUTPUT.
OPERATING CONTRACT BIDS HAVE BEEN REQUESTED.
GROUNDBREAKING TARGET IS 1967, COMPLETION 1969.
CAPACITY WILL BE 2.5 MWE, 2 MGD WATER, AND
400,000 CURIES PER YEAR OF COBALT-60 OR
PLUTONIUM-238

REFERENCES NUCLEONICS WEEK JULY 22, 1965 P. 1-2
NEWS RELEASE

WATER DESALINATION REPORT OCT. 13, 1966 P. 1
NEWS RELEASE

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BOILING LIGHT WATER REACTORS, DOMESTIC

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NAME/OWNER	DEEP-POOL REACTOR/AEC	
DESIGNER	AEC-BECHTEL	
PURPOSE	WATER DESALINATION, PROCESS HEAT	
TYPE	BWR	
POWER MWE(MWT)	400	
CRITICAL	CONCEPTUAL DESIGN	
COOLANT	DEMINERALIZED LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	RODS	
FUEL CLADDING	ZIRCALOY-2	
FUEL ENRICH.	2.75 PER CENT U-235 INITIAL	
FUEL ASSEMBLY	SQUARE ASSEMBLY 120 ASSEMBLIES/CORE ACTIVE HEIGHT 6 1/2 FT.	
FUEL CHARGE	25,000 KG. URANIUM	
BURNUP(REFUEL)	20,000 MWD/T	
CONTROL	BORON CARBIDE POWDER IN INCONEL TUBES	
COOLANT TEMP.	INLET 200 F	OUTLET 270 F
COOLANT PRESS.	77 PSIA	
REACTOR VESSEL	150 FT. DEEP TANK OF HIGH-PURITY WATER IN WHICH REACTOR CORE IS LOCATED. CARBON STEEL, 11 FT. DIA.	
CONTAINMENT	STEEL-LINED CONCRETE PIT, 100 FT. BELOW-GRADE TO 50 FT. ABOVE-GRADE. CONTROLLED VENTILATION CONCEPT	
REMARKS	DESIGN CONCEIVED BY AEC CHICAGO OPERATIONS OFFICE AND DEVELOPED BY BECHTEL IN A 6-MONTH DESIGN STUDY THE REACTOR FURNISHES POWER FOR A 50 MGD SEA-WATER CONVERSION PLANT	

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REFERENCES

DEEP-POOL REACTOR FOR WATER DESALTING
BECHTEL CORP.
COO-283 /1965/

CONCEPTUAL DESIGN OF A REACTOR FOR USE IN
DESALINATION,
US AEC CHICAGO OPERATIONS OFFICE
COO-278 /OCT. 1964/

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BOILING LIGHT WATER REACTORS, DOMESTIC

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NAME/OWNER MILLSTONE POINT STATION/CONNECTICUT L + P,
HARTFORD ELECTRIC, WESTERN MASSACHUSETTS ELEC.

DESIGNER GENERAL ELECTRIC COMPANY

LOCATION WATERFORD, CONNECTICUT

PURPOSE POWER

TYPE BWR, DIRECT CYCLE, FORCED CIRCULATION

POWER MWE(MWT) 550 1727

CRITICAL CONTRACT AWARD 1965, TARGET 1969

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS 0.488 IN. DIA.

FUEL GEOMETRY RODS, ACTIVE LENGTH 144 IN.

FUEL CLADDING ZIRCALOY-2 0.036 IN. THICK

FUEL ENRICH. AVE, 2.07 PER CENT U-235

FUEL ASSEMBLY 7X7 ROD BUNDLE, ZIRCALOY-4 CHANNEL
580 ASSEMBLIES

BURNUP(REFUEL) AVE. 15,000 MWD/T

CONTROL CRUCIFORM RODS, BORON CARBIDE

REACTOR VESSEL CYLINDER, 18 FT. 8 IN. ID/64 FT. 8 IN. LONG

CONTAINMENT STEEL AND REINFORCED CONCRETE STRUCTURE.
PRESSURE-SUPPRESSION SYSTEM.

REMARKS CONTRACT AWARD 1965

REFERENCES MILLSTONE NUCLEAR POWER STATION,
DESIGN AND ANALYSIS REPORT
CONNECTICUT LIGHT + POWER CO., HARTFORD ELECTRIC
LIGHT CO., WESTERN MASSACHUSETTS ELECTRIC CO.,
NP-16147 /ND/

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NAME/OWNER	ISRAELI BWR STUDY/US-ISRAEL JOINT BOARD
DESIGNER	KAISER ENGINEERS/CATALYTIC CONSTRUCTION CO.
PURPOSE	POWER AND DESALINATION
TYPE	BWR DIRECT CYCLE, FORCED RECIRCULATION INTERNAL STEAM SEPARATION
POWER MWE(MWT)	250 1250
CRITICAL:	ENGINEERING AND ECONOMIC FEASIBILITY STUDY
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS
FUEL GEOMETRY	ROD 0.570 IN. DIA., 12 FT. ACTIVE LENGTH
FUEL CLADDING	ZIRCALOY-2
FUEL ENRICH.	SLIGHT
FUEL ASSEMBLY	49-ROD BUNDLE 7X7, ZIRCALOY-4 CHANNEL MODULAR, STACKED. CORE IS BUILT UP OF MODULES CONSISTING OF ONE CONTROL BLADE AND FOUR FUEL ASSEMBLIES
BURNUP(REFUEL)	SCATTER, ANNUAL, 20 PER CENT
CONTROL	BORON CARBIDE PELLETS IN STAINLESS STEEL, CRUCIFORM, CONTROL OF RECIRCULATION RATE.
CONTAINMENT	PRESSURE-SUPPRESSION. DRYWELL IS A STEEL PRESSURE VESSEL VENTING INTO A TOROIDAL SUPPRESSION POOL.
REMARKS	SEE ALSO PWR STUDY WD45. THE 100 MGD DESALTING FACILITY WOULD BE A MULTI- STAGE FLASH DISTILLATION PLANT
REFERENCES	ENGINEERING FEASIBILITY, ECONOMIC STUDY FOR DUAL PURPOSE ELECTRIC POWER-WATER DESALTING PLANT. KAISER ENG., CATALYTIC CONSTR. REPORT NO. 66-I-RE /JAN. 1966/

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NAME/OWNER CORDOVA-I / COMMONWEALTH EDISON, IOWA-ILLINOIS GAS
 AND ELECTRIC
 QUAD-CITIES STATION

OPERATOR COMMONWEALTH EDISON

LOCATION CORDOVA, ILLINOIS

PURPOSE POWER

TYPE BWR-DUPLICATE OF DRESDEN-2

POWER MWE(MWT) 715
 ULTIMATE 809

CRITICAL CONTRACT AWARD APRIL 1966, TARGET MARCH 1970.

REMARKS THE UTILITIES HAVE TAKEN AN OPTION TO PURCHASE
 A SECOND UNIT FOR CORDOVA

REFERENCES NUCLEONICS WEEK APRIL 7, 1966, P. 1
 NEWS RELEASE

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NAME/OWNER MONTICELLO NUCLEAR STATION/NORTHERN STATES POWER

DESIGNER: GENERAL ELECTRIC COMPANY

OPERATOR: NORTHERN STATES POWER

LOCATION MONTICELLO, MINNESOTA /NW OF MINNEAPOLIS/

PURPOSE POWER

TYPE BWR, FORCED CIRCULATION SINGLE CYCLE

POWER MWE(MWT) 500
AFTER CORE REPLACEMENT IN 1973, 545 MWE

CRITICAL: TARGET 1970, FULL POWER NOV. 1970

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

REFERENCES NUCLEAR INDUSTRY APRIL 1966 P. 39
NEWS RELEASE

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NAME/OWNER	BROWNS FERRY NUCLEAR STATION/TVA TVA NUCLEAR STATION
DESIGNER	GENERAL ELECTRIC CO.
OPERATOR	TENNESSEE VALLEY AUTHORITY
LOCATION	BROWNS FERRY, LIMESTONE VALLEY, ALABAMA
PURPOSE	POWER
TYPE	BWR, SINGLE CYCLE, FORCED CIRCULATION TWO-REACTOR STATION
POWER MWE(MWT)	1100 PER REACTOR
CRITICAL	CONTRACT AWARD JUNE 1966
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
REFERENCES	BROWNS FERRY NUCLEAR POWER STATION, TENNESSEE VALLEY AUTHORITY, DESIGN AND ANALYSIS REPORT, TENNESSEE VALLEY AUTHORITY NP-16251 /VOL.1-2/ 1966.

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NAME/OWNER	VERMONT YANKEE/VERMONT YANKEE NUCLEAR POWER CORP.	
DESIGNER	GENERAL ELECTRIC CO.	
LOCATION	VERNON, VERMONT	
PURPOSE	POWER	
TYPE	BWR	
POWER MWE(MWT)	525	1600
CRITICAL	TARGET 1971	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
REMARKS	LETTER OF INTENT TO GE IN AUGUST 1966	
REFERENCES	NUCLEONICS WEEK AUG, 11, 1966 P. 1-2 NEWS RELEASE	

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NAME/OWNER PEACH BOTTOM-2/DELAWARE VALLEY UTILITIES
 DELAWARE VALLEY-2

DESIGNER GENERAL ELECTRIC COMPANY

OPERATOR DELAWARE VALLEY UTILITIES
 ATLANTIC CITY ELECTRIC
 PHILADELPHIA ELECTRIC

LOCATION PEACH BOTTOM, PENNA.

PURPOSE POWER

TYPE BWR

POWER MWE(MWT) 1065

CRITICAL TARGET MARCH 1971
 NO. 2 REACTOR 1973

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

REMARKS CONSTRUCTION TO BEGIN IN 1967

REFERENCES NUCLEONICS WEEK OCT. 6, 1966 P. 1
 NEWS RELEASE

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BD37

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NAME/OWNER DELAWARE VALLEY-3/DELAWARE VALLEY UTILITIES

DESIGNER GENERAL ELECTRIC CO.

OPERATOR DELAWARE VALLEY UTILITIES

LOCATION NEW JERSEY

PURPOSE POWER

TYPE BWR

POWER MWE(MWT) 1065

CRITICAL TARGET 1973

REFERENCES NUCLEONICS WEEK OCT, 6, 1966
NEWS RELEASE

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BNWL-326

BOILING LIGHT WATER REACTORS, DOMESTIC

BD38

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NAME/OWNER NIAGARA MOHAWK STATION-2/NIAGARA MOHAWK POWER CORP
DESIGNER GENERAL ELECTRIC COMPANY
OPERATOR NIAGARA MOHAWK POWER CORPORATION
LOCATION NEW YORK STATE, NINE-MILE-POINT SITE IS UNDER
 CONSIDERATION,
PURPOSE POWER
TYPE BWR
POWER MWE(MWT) 750
CRITICAL TARGET 1971-1972
REMARKS CONTRACT AWARD OCTOBER 1966
REFERENCES NUCLEONICS WEEK OCT. 31, 1966 P. 1
 NEWS RELEASE

BOILING LIGHT WATER REACTORS

FOREIGN

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BOILING LIGHT WATER REACTORS, FOREIGN

BF01

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NAME/OWNER	GAMMA PROJECT/DANATOM. DENMARK	
DESIGNER	DANATOM, DENMARK	
LOCATION	KARLBY KLINT, DJURSLAND, JUTLAND	
PURPOSE	POWER	
TYPE	BWR, INTERNAL STEAM SEPARATION, SINGLE CYCLE	
POWER MWE(MWT)	200	667
CRITICAL	DESIGN-TO BE BUILT	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	RODS , FUEL SEGMENTS OF PELLETS, EACH SEGMENT CLAD WITH ZIRCALOY-2, ARE JOINED TO FORM A FUEL ROD,	
FUEL CLADDING	ZIRCALOY-2	
FUEL ENRICH.	1.9 PERCENT U-235	
FUEL ASSEMBLY	15X15 ARRAY WITH SOME RODS OMITTED 89 ELEMENTS/CORE	
CONTROL	SPECTRAL SHIFT CONTROL HAS BEEN PROPOSED FOR STUDY	
CONTAINMENT	PRESSURE-SUPPRESSION	
REMARKS	REVISED DESIGN. /GAMMA 2/ IS FOR A SINGLE CYCLE SYSTEM.	
REFERENCES	GAMMA. A 200MW BOILING WATER REACTOR POWER STATION. DANATOM DANATOM-04-61 /AUGUST 1961/ GAMMA II-A 200MW BOILING WATER REACTOR POWER STATION. A REVISION. DANATOM DANATOM-03-62 /JUNE 1962/	

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

REMARKS FIRST FUEL LOADING WILL BE ENRICHED URANIUM, THE POSSIBILITY IS BEING CONSIDERED OF OPERATING THE PLANT, SUBSEQUENT TO FIRST LOADING, ON PLUTONIUM-ENRICHED NATURAL URANIUM FUEL. A SMALL-SCALE PROTOTYPE VERSION OF THE TARAPUR BWR IS CURRENTLY BEING DESIGNED BY INDIAN SCIENTISTS

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BF02

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AND WILL BE BUILT AT THE TROMBAY ATOMIC ENERGY
ESTABLISHMENT, INTENDED PRIMARILY FOR R+D, THE
20 MWE CAPACITY WOULD, HOWEVER, BE FED TO THE
BOMBAY POWER GRID.

REFERENCES

TARAPUR ATOMIC POWER STATION
M. N. CHAKRAVARTI, M. R. SRINIVASAN
3RD U.N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964, A/CONF.28/P/745

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BOILING LIGHT WATER REACTORS, FOREIGN

BF03

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NAME/OWNER GARIGLIANO NUCLEAR STATION/SENN, ITALY
 PUNTA FIUME

DESIGNER GENERAL ELECTRIC CO.-U.S.

OPERATOR SENN, ITALY

LOCATION PUNTA FIUME /GARIGLIANO/, ITALY

PURPOSE POWER /US-EURATOM PROGRAM/

TYPE BWR, FORCED CIRCULATION, DUAL CYCLE

POWER MWE(MWT) 150 500 INCREASE TO 230 MWE

CRITICAL JUNE 1963, SEE REMARKS

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS, SINTERED, 0.456 IN. DIA.

FUEL GEOMETRY RODS, ACTIVE LENGTH 106.5 IN.

FUEL CLADDING ZIRCALOY-2, 0.019 IN. THICK
 SEE REMARKS

FUEL ENRICH. 2.7 PER CENT U-235

FUEL ASSEMBLY 81 RODS, 9X9
 208 ASSEMBLIES IN CORE

FUEL CHARGE 97,750 LBS, URANIUM

BURNUP(REFUEL) 13,000 MWD/TON /BATCH, 20 PER CENT/

CONTROL CONTROL BLADES, TUBES FILLED WITH BORON CARBIDE
 POWDER, OPERATION IS FROM BELOW THE REACTOR
 VESSEL.

COOLANT TEMP. INLET 190.5C

COOLANT PRESS. 71.3 ATM. ABS.

REACTOR VESSEL CARBON STEEL CYLINDER, SS CLAD 141 IN. ID./5 IN.
 THICK /INCLUDING CLAD/444 1/4 IN. LONG/

CONTAINMENT SPHERE, 160 FT, DIA., CARBON STEEL, APPROX,
 0.94 IN. THICK

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BOILING LIGHT WATER REACTORS, FOREIGN

BF03

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REMARKS

TRIAL OPERATIONS WERE DISCONTINUED IN SEPTEMBER 1963 BECAUSE OF MECHANICAL BREAKDOWN, OPERATION RESUMED IN 1964. REFUELED NOV.-DEC. 1965, WITH ONE-HALF OF SS-CLAD FUEL REPLACED BY ZIRCONIUM CLAD FUEL, SENN PLANS A SECOND REACTOR AT THE SITE.

REFERENCES

THE GARIGLIANO NUCLEAR POWER STATION,
M COVINO
NUCLEAR POWER 7, 65-7 /FEBRUARY 1962/

FINAL HAZARD SUMMARY REPORT FOR THE GARIGLIANO
NUCLEAR POWER STATION,
SOCIETA ELETTRONUCLEARE NAZIONALE /SENN/, ITALY
APED-4022 /1962/

GARIGLIANO NUCLEAR POWER PLANT,
R LEPORE, OTHERS,
3RD UN INTL. CONF. ON THE PEACEFUL USES OF ATOMIC
ENERGY PAPER NO. 737 /1964/

GARIGLIANO NUCLEAR POWER PLANT
EURATOM BULLETIN NO. 4, P. 4-12 /DEC. 1963/

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BOILING LIGHT WATER REACTORS, FOREIGN

BF04

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NAME/OWNER JPDR /JAPAN POWER DEMONSTRATION REACTOR//JAERI
 DESIGNER GENERAL ELECTRIC CO.-U.S.
 OPERATOR JAERI, JAPAN
 LOCATION TOKAI-MURA, JAPAN
 PURPOSE POWER DEMONSTRATION, SHIP PROPULSION R+D
 TYPE BWR, NATURAL CIRCULATION, DIRECT CYCLE
 POWER MWE(MWT) 12.5 45
 CRITICAL AUG. 1963. ON-LINE OCT. 1963
 COOLANT LIGHT WATER
 MODERATOR LIGHT WATER
 FUEL MATERIAL URANIUM DIOXIDE CYLINDERS, SINTERED
 FUEL GEOMETRY HOLLOW TUBES.
 FUEL CLADDING SS
 FUEL ENRICH. 3.1 PER CENT U-235
 FUEL ASSEMBLY 36-ROD ASSEMBLY. EACH ROD CONSISTS OF 2 FUEL
 SEGMENTS
 72 ASSEMBLIES/CORE
 BURNUP(REFUEL) 12,000 MWD/TON U /324 DAYS FIRST CORE/
 REMARKS RESEARCH AND DEVELOPMENT IS IN PROGRESS ON JPDR-2,
 A MODIFIED VERSION OF THE GE DESIGN, SEE BF15.
 REFERENCES NUCLEAR POWERED TANKER DESIGN AND ECONOMIC
 ANALYSIS, DIRECT CYCLE BOILING WATER REACTOR.
 GEAP-3294 /DEC. 1959/
 REACTOR DESIGN REPORT FOR JPDR,
 DA VERNIER, J JACOBSON
 GEAP-3767 /1961/

JANUARY 1967

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BOILING LIGHT WATER REACTORS, FOREIGN

BF05

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NAME/OWNER	DODEWAARD NUCLEAR STATION/GKN SEP BWR
DESIGNER	GENERAL ELECTRIC COMPANY
OPERATOR	NV GEMEENSCHAPPELIJKE KERNENERGIECENTRALE NEDERLAND /GKN/ JOINT NETHERLANDS NUCLEAR POWER STATION
LOCATION	DODEWAARD, THE NETHERLANDS
PURPOSE	POWER
TYPE	BWR DIRECT CYCLE, NATURAL CIRCULATION
POWER MWE(MWT)	50 165
CRITICAL	TARGET 1968
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS
FUEL GEOMETRY	RODS-ANNULAR
FUEL CLADDING	ZIRCALOY-2 OR STAINLESS STEEL.
FUEL ENRICH.	2.5 PER CENT U-235
FUEL ASSEMBLY	36-ROD ASSEMBLY 156 ELEMENTS/CORE
FUEL CHARGE	13000 KG. URANIUM
SPECIFIC POWER	30 KW/LITER OF CORE VOLUME
BURNUP(REFUEL)	13,000 MWD/TU
CONTROL	SS TUBES CONTAINING BORON CARBIDE
REACTOR VESSEL	CYLINDRICAL VESSEL 3 M. ID./11 M. LONG, STEEL WITH SS LINING. VESSEL CONTAINS CORE AND SUPPORT STRUCTURE, STEAM-WATER SEPARATOR, AND STEAM DRIER.
CONTAINMENT	REACTOR BUILDING, PRESSURE-SUPPRESSION SYSTEM,
REMARKS	SEP ENGINEERS WORKING WITH GE WILL DO PRELIMINARY DESIGN, SCOPING, AND ECONOMIC STUDIES. EURATOM

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BOILING LIGHT WATER REACTORS, FOREIGN

BF05

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HAS EAR-MARKED CONSTRUCTION FUNDS FOR THE PROJECT.

REFERENCES

THE DUTCH NUCLEAR POWER PLANT PROJECT.

JS TERPSTRA

EURATOM BULLETIN NO. 4, 28-9 /DEC. 1963/

DODEWAARD NUCLEAR POWER STATION

P MOSTERT

EURONUCLEAR 3, 37-40 /JAN. 1966/

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BOILING LIGHT WATER REACTORS: FOREIGN

BF06

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NAME/OWNER	SIMPEVARP REACTOR/OKAB, SWEDEN OSKARSHAMM NUCLEAR POWER STATION	
DESIGNER	ASEA, SWEDEN	
OPERATOR	OSKARSHAMMSVERKETS KRAFTGRUPP AB /OKAB/, SWEDEN	
LOCATION	OSKARSHAMM, SIMPEVARP PENINSULA, SWEDEN	
PURPOSE	POWER	
TYPE	BWR DIRECT CYCLE, FORCED CIRCULATION	
POWER MWE(MWT)	400	1250
CRITICAL	CONSTRUCTION 1966, TARGET 1970	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL CLADDING	ZIRCALOY-2 TUBES	
FUEL ENRICH.	2-2.5 PER CENT U-235	
FUEL CHARGE	90 TONS URANIUM	
BURNUP(REFUEL)	20,000 MWD/T	ANNUAL, ONE-HALF CHARGE
CONTROL	CRUCIFORM RODS WITH BORON CARBIDE	
CONTAINMENT	PRESSURE-SUPPRESSION	
REMARKS	CONTRACT AWARD TO ASEA IN JULY 1965, CONSTRUCTION SCHEDULED FOR SPRING 1966, TARGET 1970	
REFERENCES	OSKARSHAMM NUCLEAR POWER STATION EURONUCLEAR 2, 382-3 /AUG. 1965/ SWEDEN-5 LARGEST NUCLEAR POWER STATION ENGINEERING 200, 141 /JULY 30, 1965/	

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BOILING LIGHT WATER REACTORS, FOREIGN

BF07

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NAME/OWNER IBR /INTEGRAL BOILING REACTOR/AEA, UNITED KINGDOM,

DESIGNER UK AEA

PURPOSE SHIP PROPULSION

TYPE BWR, DIRECT OR INDIRECT CYCLE. PRESSURE TUBE.

POWER MWE(MWT) 60

CRITICAL CONCEPT

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL GEOMETRY PINS

FUEL CLADDING SS OR ZR TUBES

FUEL ENRICH. 5 PER CENT U-235

FUEL ASSEMBLY FUEL PINS CLUSTERED AROUND CENTRAL BURNABLE POISON PIN, AND MOUNTED WITH IN A ZIRCONIUM-NIOBIUM ALLOY SHROUD.

REMARKS THE AEA HAS STUDIED THIS CONCEPT, AND THE BELGIUM CONCEPT VULCAIN, IN THEIR SHIP PROPULSION PROGRAM. TWO VERSIONS OF THE IBR WERE BEING INVESTIGATED. INDIRECT CYCLE, IN WHICH THE TUBES CONTAINING THE FUEL ELEMENTS ARE CLOSED AND INTERCONNECTED TO FORM A CIRCUIT THROUGH WHICH HIGH PRESSURE WATER IS PUMPED AS AN INTERMEDIATE IN THE MAIN COOLANT, AND DIRECT CYCLE, IN WHICH THE TUBES CONTAINING THE FUEL ARE OPEN AT THE ENDS THE COOLANT FLOWING DIRECTLY OVER THE FUEL. BOILING TAKES PLACE IN THE CORE. THE PRIMARY COOLANT PUMP, STEAM SEPARATORS AND PRESSURIZER ARE ALL WITHIN THE REACTOR VESSEL.

REFERENCES THE U. K. ATOMIC ENERGY AUTHORITY'S NUCLEAR SHIP CONCEPTS,
NUCLEAR ENG. 8, 88-9 /MARCH 1963/

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BOILING LIGHT WATER REACTORS, FOREIGN

BF08

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NAME/OWNER	ULYANOVSK ATOMIC POWER STATION/CENTRAL ATOMIC ENERGY UTILIZATION BOARD, USSR.	
DESIGNER	USSR	
OPERATOR	CENTRAL ATOMIC ENERGY UTILIZATION BOARD	
LOCATION	MELEKES /ULYANOVSK REGION/ USSR	
PURPOSE	POWER	
TYPE	BWR, DIRECT CYCLE	
POWER MWE(MWT)	70	250
CRITICAL	1965	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	RODS	
FUEL CLADDING	NIOBIUM-ZIRCONIUM ALLOY	
FUEL ENRICH.	1.5 PER CENT U-235	
FUEL ASSEMBLY	91 FUEL RODS, HEXAGONAL 187 ASSEMBLIES/CORE	
FUEL CHARGE	26 TONS ENRICHED URANIUM	
SPECIFIC POWER	9.6 KW/KG ENRICHED URANIUM	
NEUTRON FLUX	THERMAL AVE. 3×10^{13}	
CONTROL	CONTROL RODS	
COOLANT TEMP.	236-310 C	
COOLANT PRESS.	32-100 KG/SQ. CM.	
REACTOR VESSEL	CYLINDER, BOILER PLATE STEEL 11.2 M. HIGH, 3.8 M. DIA, 10 CM. THICK	
REMARKS	THE COOLANT WATER FLOWS INTO AN ANNULUS BETWEEN THE STEEL PRESSURE VESSEL WALL AND THE CORE. FLOWS DOWNWARD. PASSES OVER THE FUEL	

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BOILING LIGHT WATER REACTORS, FOREIGN

BF08

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ELEMENTS IN THE CORE FROM THE BOTTOM TO THE TOP,
LEAVES THE REACTOR AND GOES TO THE STEAM
GENERATORS,

REFERENCES

DOUBLE WATER CIRCUIT POWER REACTORS IN THE USSR,
SA SKORTSOV
SOVIET J. ATOMIC ENERGY 5, 1107-19
/SEPTEMBER 1958/

VOL. I. POWER REACTORS, PP. 73-5
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1959,

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BOILING LIGHT WATER REACTORS, FOREIGN

BF09

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NAME/OWNER BELOYARSK STATION/MINISTRY OF POWER, USSR.
PROJECT-1

DESIGNER USSR

OPERATOR MINISTRY OF POWER STATIONS

LOCATION BELOYARSK URALS, USSR.

PURPOSE POWER

TYPE BWR, NUCLEAR SUPERHEAT, PRESSURE TUBE,
2-REACTOR STATION.

POWER MWE(MWT) 94 286 /BELOYARSK-1/
 200 560 /BELOYARSK-2/

CRITICAL BELOYARSK-1, 1964
BELOYARSK-2, TARGET 1966-1967

COOLANT LIGHT WATER AND STEAM

MODERATOR GRAPHITE

FUEL MATERIAL URANIUM-MOLYBDENUM ALLOY

FUEL GEOMETRY ANNULAR /HOLLOW/ CYLINDERS, 600 CM. LONG,

FUEL CLADDING SS INNER AND OUTER

FUEL ENRICH. BELOYARSK-1, 1.5 PER CENT U-235
BELOYARSK-2, 3.0 PER CENT U-235

FUEL ASSEMBLY 6 CYLINDERS, HEXAGONAL
750 BOILING REGION
268 STEAM COOLED /SECONDARY STEAM/

FUEL CHARGE 15,880 KG. URANIUM

SPECIFIC POWER 3.2 KW/KG ENRICHED URANIUM

BURNUP(REFUEL) BELOYARSK-1, 4000 MWD/T
BELOYARSK-2, 10000 MWD/T

NEUTRON FLUX MAX. 2×10^{13}

CONTROL CONTROL RODS

COOLANT TEMP. INLET 300 C OUTLET 340 C

COOLANT PRESS. 150 ATM.

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BF09

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REACTOR VESSEL CYLINDER, CARBON STEEL, 9.6 M. HIGH, 9.0 M. DIA.

CONTAINMENT NONE OTHER THAN REACTOR HALL.

REMARKS THE SECOND REACTOR, NOW UNDER CONSTRUCTION, WILL BE RATED AT 200 MWE, 560 MWT, USING ANNULAR ELEMENTS WITH LARGER ANNULI BUT THE SAME OD, AND 3 PER CENT ENRICHED URANIUM. A THIRD PLANT IS BEING STUDIED FOR THE BELOYARSK COMPLEX, WITH 1000 MWE AND 2220 MWT POWER RATING. 5 PER CENT ENRICHED U WOULD BE USED, WITH A BURNUP OF 40,000 MWD/TON. THE SECOND PLANT IS EXPECTED TO HAVE A BURNUP OF 10,000 MWD/TON.

REFERENCES URANIUM-GRAPHITE REACTORS WITH SUPERHEATED STEAM FOR ELECTRIC POWER STATIONS,

NA DOLLEZHAL

SOV. J. ATOMIC ENERGY 5, 1085-1106 /SEPTEMBER 1958/

STEAM COOLED POWER REACTOR EVALUATION-BELOYARSK /URAL/ REACTOR.

GENERAL ELECTRIC COMPANY, HANFORD HW-67473 /APRIL 1961/

EXPERIMENTAL UNIFLOW STEAM SUPERHEATING REACTOR INSTALLATION OF THE FIRST ATOMIC POWER PLANT.

VV KOLOGOV, OTHERS

FTD-TT-61-340 /1962/ /TRANSLATION/

URANIUM GRAPHITE POWER REACTOR WITH DIRECT FEEDING OF STEAM TO TURBINES.

NA DOLLEZHAL, OTHERS

FTD-TT-61-342 /1962/ /TRANSLATION/

ATOMIC ENERGY IN THE SOVIET UNION.

TRIP REPORT OF THE U.S. ATOMIC ENERGY DELEGATION MAY 1963

OPERATION OF THE FIRST NUCLEAR POWER PLANT IN THE WORLD.

GN USHAKOV, OTHERS.

ATOMNAYA ENERGIYA 16,484-8 /1964/

AEC-TR-6463 /TRANSLATION/

IV KURCHATOV BELOYARSK NUCLEAR POWER PLANT.

PI ALESHCHENKOV, VM SHUVALOV

ATOMNAYA ENERGIYA 16,489-96 /1964/

AEC-TR-6462 /TRANSLATION/

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BOILING LIGHT WATER REACTORS. FOREIGN

BF09

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START-UP AND PILOT OPERATION OF THE FIRST UNIT OF
THE BELOYARSK NUCLEAR POWER STATION AFTER I.V.
KURCHATOV.

AN GRIGORYANTS, OTHERS

3RD N.N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, 1964, A/CONF. 28/P/308

WORLD-S POWER REACTORS 1966. CHART.
NUCLEAR ENGINEERING APRIL 1966

JANUARY 1967

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BOILING LIGHT WATER REACTORS, FOREIGN

BF10

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NAME/OWNER KAHL EXP, HIGH TEMPERATURE REACTOR/RWE AND BAYERN,
RWE-1, VAK REACTOR

DESIGNER GE/AEG, US AND W. GERMANY

OPERATOR VERSUCHSATOMKRAFTWERK KAHL GMBH /VAK/, W. GERMANY
RWE AND BAYERNWERK AG

LOCATION KAHL-AM-MAIN, W. GERMANY

PURPOSE POWER EXPERIMENT

TYPE BWR, NATURAL CIRCULATION, INDIRECT CYCLE.
FORCED CIRCULATION CAN BE ADDED AT A LATER DATE,
SUPERHEAT WILL BE ADDED.

POWER MWE(MWT) 15 60

CRITICAL NOV. 1960, FULL POWER DEC. 1961

FUEL MATERIAL URANIUM DIOXIDE SINTERED PELLETS, 0.5 IN. DIA./
0.63 IN. LONG

FUEL GEOMETRY ROD, ACTIVE LENGTH 29.9 IN.

FUEL CLADDING ZIRCALOY, 0.85 MM. WALL THICKNESS

FUEL ENRICH. 2.3-2.6 PER CENT U- 235 /1ST CORE, 4 ZONE
ENRICHMENT/

FUEL ASSEMBLY 72 RODS, TWO LAYERS, 6X6 --
88 ASSEMBLIES/CORE

FUEL CHARGE 5545KG. URANIUM

BURNUP(REFUEL) 8800 MWD/T BY ZONES

NEUTRON FLUX THERMAL AVE, 1.5×10^{13}

CONTROL RODS, 2 PER CENT ENRICHED BORIDED SS

COOLANT TEMP. 286C

COOLANT PRESS. 1000 PSIG

REACTOR VESSEL STEEL CYLINDER DOMED ENDS, 27 FT. 9 IN. HIGH,
8 FT. ID. CLAD, SS.

CONTAINMENT CYLINDER, DOMED ENDS, 106 FT. HIGH, 45 FT. DIA.

REMARKS A PROVISION HAS BEEN MADE FOR DOUBLING THE DESIGN

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BF10

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POWER. SECOND TURBOSET MAY BE OPERATED IN DIRECT CYCLE. AEG WILL DEVELOP THE CONCEPT IN A STUDY OF A SUPERHEAT STEAM PLANT /SEE RWE-BAYERNWERK AG STATION/, AEG HAS ALSO ANNOUNCED THAT A PROTOTYPE SUPERHEAT REACTOR WITH A CAPACITY OF 100 MWT WILL BE CONSTRUCTED NEAR KAHL, WITH COMPLETION SCHEDULED FOR 1968.

REFERENCES

THE KAHL NUCLEAR POWER STATION.
HJ BRUCHNER
NUCLEAR POWER 6. 67-70 /MARCH 1961/

COMMISSIONING KAHL-S 15 MW BWR.
R KUHNEL, R MISENTA
NUCLEAR ENGINEERING 7. 407-14 /OCTOBER 1962/

THE 15 EMW NUCLEAR POWER STATION WITH BOILING WATER REACTOR AT KAHL/MAIN /FEDERAL REPUBLIC OF GERMANY/.
HJ BRUCHNER
SYMP. ON SMALL AND MEDIUM POWER REACTORS.
PAPER SMPR/19
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA,
SEPTEMBER 5-9, 1960.

BF 11

NAME/OWNER	KRB NUCLEAR STATION/KRB, W, GERMANY RWE-BAYERNWERK
DESIGNER	ALLGEMEINE ELECTRIZITATS GESELLSCHAFT, /AEG/
OPERATOR	KERNKRAFTWERK RWE-BAYERNWERK GMBH /KRB/
LOCATION	GUNDRENINGEN, BAVARIA, W, GERMANY /ON DANUBE/
PURPOSE	POWER US-EURATOM
TYPE	BWR, DUAL CYCLE, FORCED CIRCULATION
POWER MWE(MWT)	237 801
CRITICAL	CRITICAL AUG. 1966
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS
FUEL GEOMETRY	ROD 3.30 M. ACTIVE LENGTH
FUEL CLADDING	ZIRCALOY-2 0.889 IN. THICK
FUEL ENRICH.	AVE. 2.24 PER CENT U-235
FUEL ASSEMBLY	36-ROD BUNDLE, 6X6 IN ZIRCALOY-4 CHANNEL 89 FUEL ELEMENT CELLS MAKE UP THE CORE. EACH CELL CONSISTS OF 4 ELEMENTS WITH A CENTRAL CONTROL ROD, 12 SINGLE ELEMENTS ARE ARRANGED ON THE PERIPHERY OF THE CORE.
FUEL CHARGE	53 TONS URANIUM DIOXIDE
BURNUP(REFUEL)	16,500 MWD/TU ANNUAL 90 ELEMENTS/YEAR
CONTROL	CRUCIFORM RODS, BORON CARBIDE ABSORBER MATERIAL, POISON CURTAINS.
COOLANT TEMP.	INLET 266 C
COOLANT PRESS.	71.3 ATM. ABS.
REACTOR VESSEL	STEEL VESSEL 3.71 M. ID., 16.5 M. HIGH,

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BOILING LIGHT WATER REACTORS, FOREIGN

BF11

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WALL THICKNESS 121 MM.
SS CLAD 7 MM. THICK

CONTAINMENT CONCRETE SHELL, AIR GAP, AND STEEL CONTAINMENT.
STEEL STRUCTURE IS 30 M. ID., 60 M. HIGH, WITH
WALL THICKNESS 13.5/26.5 MM.
CONCRETE SHELL THICKNESS 38 CM.
WIDTH OF AIR GAP 15 CM.

REMARKS THE REACTOR IS A DEVELOPMENT OF THE US. GE.
DESIGNED RWE-1 REACTOR.

REFERENCES THE GENERAL ELECTRIC COMPANY 100 MEGAWATT NATURAL
CIRCULATION BOILING WATER REACTOR POWER PLANT.
GENERAL ELECTRIC CO., APED
TID-15057 /1960/

THE 150 MWE ATOMIC POWER STATION WITH AN
EVAPORATING REACTOR, DESIGNED BY AEG.
E MOLDOVANYI
ENERGIA ES ATOMTECH. /HUNGARY/ 15, 139-43
/MARCH 1962/

THE NUCLEAR POWER STATION GUNDREMMINGEN OF THE
KERNKRAFTWERK RWE-BAYERNWERK GMBH,
K PENSTER
BRENNSTOFFE-WAERME-KRAFT 16, 227-30 /MAY 1964/

THE GUNDREMMINGEN NUCLEAR POWER PLANT.
I DESFOSSES, OTHERS.
EURATOM BULLET IN NO. 4, 26-27 /DEC. 1963/

KRB GUNDREMMINGEN NUCLEAR POWER STATION
R JAERSHKY, R TAURIT
EURONUCLEAR 3, 212-26 /MAY 1966/

JANUARY 1967

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BOILING LIGHT WATER REACTORS, FOREIGN

BF12

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NAME/OWNER BWR STUDY/AEG, DEUTSCH WERFT, W. GERMANY

DESIGNER AEG, W. GERMANY

PURPOSE SHIP PROPULSION

TYPE BWR

CRITICAL STUDY

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

REMARKS DEUTSCHE WERFT AG HAS ANNOUNCED PLANS TO BUILD A
FREIGHTER OF AT LEAST 45,000 TONS TO BE POWERED BY
A BWR. STUDY AND DEVELOPMENT OF THE PLANS WAS
DONE IN COOPERATION WITH AEG.

REFERENCES ENERGIE NUCLEAIRE, JULY-AUGUST 1962, P, 296
NEWS RELEASE.

JANUARY 1967

BNWL-326

BOILING LIGHT WATER REACTORS. FOREIGN

BF13

* * * * *

NAME/OWNER	LINGEN BWR/KERNKRAFTWERK LINGEN GMBH VEW STATION
DESIGNER	AEG, W. GERMANY
OPERATOR	KERNKRAFTWERK-LINGEN, W. GERMANY
LOCATION	DORTMUND-EMS CANAL, NORTH OF MUENSTEN, WESTPHALIA
PURPOSE	POWER
TYPE	BWR INDIRECT CYCLE, OIL-FIRED SUPERHEAT.
POWER MWE(MWT)	240 514
CRITICAL	PLANNED. TARGET 1968
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS
FUEL ENRICH.	2.4 PER CENT U-235
FUEL ASSEMBLY	36-ROD CLUSTER, SQUARE ZIRCALOY CASING 316 ELEMENTS/CORE
FUEL CHARGE	34 TONS URANIUM
CONTROL	STEEL TUBES WITH BORON CARBIDE
CONTAINMENT	STEEL VESSEL
REMARKS	A JOINT PROJECT FOR A 240 MWE PLANT USING THE AEG-SUPPLIED 160 MWE BWR REACTOR WITH A 90 MWE OIL-FIRED SUPERHEATER. SITE PREPARATION WAS STARTED IN OCTOBER 1964.
REFERENCES	THE LINGEN NUCLEAR POWER STATION O DEUBLEIN ATOMWIRTSCHAFT 10. 162-9 /APRIL 1965/

JANUARY 1967

BNWL-326

BOILING LIGHT WATER REACTORS, FOREIGN

BF14

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NAME/OWNER	CANDU-BLW /CANDU-BOILING LIGHT WATER//AECL GENTILLY NUCLEAR STATION	
DESIGNER	AECL, HYDRO-QUEBEC, CANADA	
LOCATION	POINTE-AUX-ROCHES, NEAR GENTILLY AND BECANCOUR, QUEBEC, CANADA	
PURPOSE	POWER	
TYPE	BWR, HEAVY WATER MODERATED, DIRECT CYCLE, VERTICAL PRESSURE TUBE /CALANDRIA/.	
POWER MWE(MWT)	500 MWE DEMONSTRATION 250 MWE	803 MWT
CRITICAL	PROTOTYPE TARGET 1971	
COOLANT	LIGHT WATER	
MODERATOR	HEAVY WATER, HEAVY WATER REFLECTOR.	
FUEL MATERIAL	URANIUM DIOXIDE	
FUEL GEOMETRY	TUBE-IN-SHELL WITH 22 COOLANT TUBES PER ELEMENT SEE REMARKS	
FUEL CLADDING	ZIRCONIUM SHELL	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	FUEL SECTIONS OF CONVENIENT LENGTH CONNECTED TOGETHER BY SLIDING DOVE-TAIL JOINTS /STACKED/ IN PRESSURE TUBES, 324 FUEL TUBES/CORE SEE REMARKS	
FUEL CHARGE	101.9 TON URANIUM	
SPECIFIC POWER	12.2 KW/CM	
BURNUP(REFUEL)	10.343 MWD/T	ON-LOAD, FROM BOTTOM.
CONTROL	HORIZONTAL BOOSTER RODS OF ENRICHED URANIUM ZIRCALOY TUBES WITH HELIUM-3 AS ABSORBER ELEMENTS SOLUBLE POISON ADDITION OR REMOVAL FROM MODERATOR	
COOLANT TEMP.	INLET 505.3 F	OUTLET 542.5 F
COOLANT PRESS.		OUTLET 980 PSIA

JANUARY 1967

BNWL=326

BOILING LIGHT WATER REACTORS, FOREIGN

BF14

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REACTOR VESSEL SS VERTICAL CYLINDER 30 FT. DIA./ 23 FT. HIGH,
CALANDRIA TUBES ZIRCALOY-2, AND PRESSURE TUBES A
ZIRCONIUM-NIOBIUM ALLOY.

CONTAINMENT REINFORCED CONCRETE SHELL 100 FT. DIA., 182 FT.
HIGH, HOUSING REACTOR VESSEL, VAULT, OTHER
EQUIPMENT.

REMARKS CONCEPT IS A VARIANT OF CANDU. AECL AND HYDRO-
QUEBEC HAVE NEGOTIATED ON THE CONSTRUCTION OF A
250 MWE PROTOTYPE, 19,22, AND 28-ROD ASSEMBLIES
WERE CONSIDERED, BUT PRESENT DEVELOPMENT IS
PROCEEDING ON A TUBE-IN-SHELL CONFIGURATION, WHICH
IS A MASSIVE ELEMENT PENETRATED BY COOLANT TUBES.
CLADDING WOULD BE A SHELL STRUCTURE,
COOLANT FLOW IS THROUGH FUEL ELEMENT TUBES AND
ALSO THROUGH THE ANNULUS BETWEEN THE ELEMENT AND
THE PRESSURE TUBE.
IN THE PROTOTYPE DESIGN THE TUBE-IN-SHELL ELEMENTS
ARE REPLACED BY 18-ROD BUNDLES AS IN DOUGLAS
POINT.
JAPAN WILL DEVELOP AN ADVANCED CONVERTER BASED ON
CANDU-BLW, WITH 200-MWE PROTOTYPE CONSTRUCTION
IN 1969

REFERENCES QUEBEC WILL GET CANDU-BLW REACTOR.
CANADIAN CHEM. PROCESSING 49, 57-62 /MAY 1965/

SECOND-GENERATION CANDU
NUCLEAR ENG. 10, 301-2 /AUG. 1965/

NUCLEAR CANADA JUNE 1966 P. 3-4
NEWS RELEASE

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BOILING LIGHT WATER REACTORS, FOREIGN

BF15

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NAME/OWNER JAPCO TSURUGA STATION/JAPAN ATOMIC POWER CO.
DESIGNER GENERAL ELECTRIC COMPANY
OPERATOR JAPAN ATOMIC POWER CO. /JAPCO/
LOCATION TSURUGA, JAPAN, ON SEA OF JAPAN.
TYPE BWR, FORCED CIRCULATION, HIGH POWER DENSITY
POWER MWE(MWT) 310
CRITICAL: CONSTRUCTION 1966. TARGET 1970
COOLANT LIGHT WATER
MODERATOR LIGHT WATER
REMARKS RESEARCH AND DEVELOPMENT, MODIFICATION OF THE GE
JPDR-1 REACTOR.
REFERENCES RESEARCH AND DEVELOPMENT OF JPDR-2
A FORCED CIRCULATION, HIGH POWER DENSITY BOILING
WATER REACTOR,
J MIIDA, K MOCHIZUKI
NIPPON GENSHEIYOKU GAKKAISHI 6, 350-5 /JUNE 1964/

NUCLEONICS WEEK OCT, 7, 1965 P. 2
NEWS RELEASE

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BNWL#326

BOILING LIGHT WATER REACTORS, FOREIGN

BF16

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NAME/OWNER	FUKUSHIMA NUCLEAR STATION/TOKYO ELECTRIC POWER CO.
DESIGNER	GENERAL ELECTRIC COMPANY
OPERATOR	TOKYO ELECTRIC POWER CO., JAPAN
LOCATION	FUKUSHIMA, NORTHERN HONSHU, JAPAN
TYPE	BWR
POWER MWE(MWT)	440
CRITICAL	CONSTRUCTION 1966. TARGET 1971
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL ENRICH.	LOW
REMARKS	CONTRACT SIGNED MAY 1966
REFERENCES	NEWS RELEASES

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BNWL-326

BOILING LIGHT WATER REACTORS, FOREIGN

BF17

* * * * *

NAME/OWNER SANTA MARIA DE GARONA STATION/NUCLENOR, SPAIN

DESIGNER GENERAL ELECTRIC CO.

OPERATOR CENTRALES NUCLEARES DEL NORTE SA /NUCLENOR/ SPAIN

LOCATION SANTA MARIA DE GARONA, SPAIN
NEAR BURGOS

PURPOSE POWER

TYPE BWR

POWER MWE(MWT) 440 1481

CRITICAL CONSTRUCTION TARGET 1970

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL GEOMETRY ROD

REACTOR VESSEL CYLINDER COMPOSED OF FORGED STEEL RINGS,
5.5 M. OD.
WALL THICKNESS 120-150 MM.

REFERENCES NEWS RELEASES.

JANUARY 1967

BNWL #326

BOILING LIGHT WATER REACTORS: FOREIGN

BF18

* * * * *

NAME/OWNER	BKW REACTOR/BKW, SWITZERLAND
DESIGNER	GENERAL ELECTRIC CO., BROWN BOVERI
OPERATOR	BERNISCHE KRAFTWERK, SWITZERLAND
LOCATION	MUHLEBERG, BERNE, SWITZERLAND
PURPOSE	POWER
TYPE	BWR
POWER MWE(MWT)	300
CRITICAL	CONTRACT AWARD 1966 TARGET 1971
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
REFERENCES	NUCLEONICS WEEK SEPT. 8, 1966 P. 3 NEWS RELEASE

CAVITY (GAS CORE) REACTORS

DOMESTIC

JANUARY 1967

BNWL-326

CAVITY (GAS CORE) REACTORS, DOMESTIC

CD01

* * * * *

NAME/OWNER GASEOUS FUEL REACTOR STUDY/BURNS AND ROE

DESIGNER BURNS AND ROE INC.

PURPOSE SPACE PROPULSION

TYPE GASEOUS FUEL

POWER MWE(MWT) 30

CRITICAL STUDY

COOLANT HELIUM

MODERATOR GRAPHITE REFLECTOR

FUEL MATERIAL URANIUM HEXAFLUORIDE, GASEOUS FUEL WITH BROMINE
TRIFLUORIDE ADDED.

REMARKS A GASEOUS CORE REACTOR USING URANIUM HEXAFLUORIDE
AS FUEL AND HELIUM AS AN INTERNAL COOLANT
PROPOSED FOR SPACE PROPULSION UNIT. CORE
CHANNELS ARE OF ALUMINUM DOUBLE TUBE WALL.
URANIUM HEXAFLUORIDE IS INSIDE THE ALUMINUM TUBES,
HELIUM IS IN THE ANNULUS. COOLANT FLOW IS BY
NATURAL CIRCULATION. THERE IS A GRAPHITE
REFLECTOR.

REFERENCES GASEOUS-FUEL REACTOR.
S BARON
NUCLEONICS 16, 128, 130-33 /AUGUST 1958/

JANUARY 1967

BNWL-326

CAVITY (GAS CORE) REACTORS, DOMESTIC

CD02

* * * * *

NAME/OWNER GASEOUS CORE REACTOR STUDY/GE

DESIGNER GENERAL ELECTRIC COMPANY
FLIGHT PROPULSION LAB.

PURPOSE SPACE PROPULSION

TYPE GASEOUS /PLASMA/ FUEL

CRITICAL STUDY

MODERATOR PROPELLANT

FUEL MATERIAL FISSIONABLE MATERIAL IN A PLASMA STATE

REMARKS FEASIBILITY STUDY OF A CAVITY REACTOR, THE
FISSIONABLE MATERIAL EXISTS IN THE GASEOUS
/PLASMA/ STATE, THE MODERATING PROPELLANT
IS HEATED BY FISSIONABLE FUEL AND FLOWS OUT AN
EXHAUST NOZZLE TO PRODUCE THRUST. FUEL AND
PROPELLANT ARE SEPARATED BY HYDRODYNAMIC METHODS.REFERENCES A GASEOUS-CORE NUCLEAR ROCKET UTILIZING
HYDRODYNAMIC RETENTION OF FISSIONABLE MATERIAL.
J GREY
PRESENTED AT THE ARS SEMI-ANNUAL MEETING,
JUNE 8-11, 1959, SAN DIEGO, CALIFORNIA, /1959/

JANUARY 1967

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CAVITY (GAS CORE) REACTORS, DOMESTIC

CD03

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NAME/OWNER GASEOUS CORE REACTOR STUDY/LASL

DESIGNER LOS ALAMOS SCIENTIFIC LABORATORY

PURPOSE DIRECT ELECTRIC POWER, FEASIBILITY STUDY

TYPE GASEOUS /PLASMA/ FUEL

MODERATOR GRAPHITE /HEAVY WATER BLANKET/

FUEL MATERIAL FISSIONABLE GAS, URANIUM-235 OR PLUTONIUM-239

REMARKS THE REACTOR IS A GRAPHITE CYLINDER FILLED WITH A
FISSIONABLE GAS /FISSION=PLASMA REACTOR/. ENERGY
RELEASED IN THE FISSION PULSE INDUCES A CURRENT IN
A COIL WRAPPED AROUND THE GRAPHITE CYLINDER. THE
HEAVY WATER BLANKET SURROUNDS THE GRAPHITE.

REFERENCES PLASMA REACTOR PROMISES DIRECT ELECTRIC POWER.
S. A. COLGATE, RL AAMODT
NUCLEONICS 15, 50-55 /AUGUST 1957/

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CAVITY (GAS CORE) REACTORS. DOMESTIC

CD04

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NAME/OWNER GASEOUS CORE REACTOR STUDY-2/LEWIS RESEARCH CENTER
WHEEL-FLOW GASEOUS CORE REACTOR

DESIGNER NASA LEWIS RESEARCH CENTER

PURPOSE ROCKET PROPULSION CONCEPTUAL STUDY

TYPE GASEOUS FUEL, COAXIAL FLOW

MODERATOR GRAPHITE OR HEAVY WATER

FUEL MATERIAL FISSIONABLE GAS, URANIUM-235 OR PLUTONIUM-239

REMARKS GASEOUS FUEL IS IN A CAVITY REGION SURROUNDED BY A REFLECTOR-MODERATOR REGION. CYLINDRICAL GEOMETRY WAS STUDIED AS BEING MORE APPLICABLE THAN SPHERICAL FOR ROCKET USE. FUEL REGION IS CENTRALLY LOCATED IN CAVITY REGION, EXTENDING ENTIRE LENGTH OF THE CAVITY. FUEL IS CONTAINED BY FLOW THROUGH VORTEX TUBES. BY MEANS OF SEPARATE COAXIAL STREAMS IN WHICH FUEL FLOW IS AT LOW VELOCITY RELATIVE TO THE PROPELLANT. AND BY USE OF MAGNETIC FORCES TO CONFINE THE FUEL TO A PARTICULAR REGION. STUDY IS OF A CAVITY REACTOR WITH FUEL AND CAVITY REGIONS COMPLETELY ENCLOSED BY A REFLECTOR-MODERATOR 100 CM. THICK.

REFERENCES TWO-DIMENSIONAL CRITICALITY CALCULATIONS OF GASEOUS-CORE CYLINDRICAL-CAVITY REACTORS. RE HYLAND, OTHERS /LEWIS RESEARCH CENTER/ NASA-TN-D-1575 /MARCH 1963/

WHEEL-FLOW GASEOUS CORE REACTOR CONCEPT,
JC EVVARD
NASA-TN-D-2951 /NOV, 1965/

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CAVITY (GAS CORE) REACTORS, DOMESTIC

CD05

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NAME/OWNER UAC ROCKET REACTOR STUDY / UAC, NASA

DESIGNER UNITED AIRCRAFT CORPORATION

PURPOSE ROCKET PROPULSION

TYPE GASEOUS FUEL, VORTEX FLOW, VERY HIGH TEMPERATURE

CRITICAL STUDY

FUEL MATERIAL PLUTONIUM FUEL WILL BE STUDIED

REMARKS UAC RECEIVED A NASA CONTRACT FOR INVESTIGATION OF GASEOUS NUCLEAR ROCKET TECHNOLOGY. WATER, METHANE AND AMMONIA PROPELLANTS AND PLUTONIUM FUEL WILL BE STUDIED. THE VORTEX METHOD OF FUEL CONTAINMENT WILL BE LOOKED AT. UNDER A SEPARATE CONTRACT UAC WILL STUDY ANOTHER APPROACH TO SEPARATING FUEL AND PROPELLANT INSIDE THE REACTOR CORE. JPL IS ALSO INVESTIGATING A VORTEX SYSTEM.

REFERENCES NUCLEONICS WEEK JAN, 30, 1964 P 4,
NEWS RELEASE.

JANUARY 1967

BNWL-326

CAVITY (GAS CORE) REACTORS, DOMESTIC

CD06

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NAME/OWNER GASEOUS CORE REACTOR POWER STATION STUDY/PURDUE

DESIGNER PURDUE UNIVERSITY

PURPOSE CENTRAL STATION POWER

TYPE GASEOUS /CAVITY/ CORE, FORCED CIRCULATION OF FUEL

POWER MWE(MWT) 1000 2800

CRITICAL DESIGN

COOLANT GASEOUS FUEL MIXTURE
SECONDARY SYSTEM, WATER

MODERATOR EXTERNAL HEAVY WATER REFLECTOR

FUEL MATERIAL CORE, URANIUM HEXAFLUORIDE IN FLUORINE-HELIUM MIX.
BLANKET, THORIUM DIOXIDE-HEAVY WATER SOLUTION

FUEL GEOMETRY GAS

FUEL ENRICH. 100 PER CENT

FUEL ASSEMBLY CORE IS A SPHERICAL CAVITY 243 CM. RADIUS.
GASEOUS FUEL CIRCULATES THROUGH CORE AND
PRIMARY COOLANT LOOPS BY BLOWERS
REFLECTOR IS SEPARATED FROM CORE CAVITY BY THE
PRESSURE VESSEL, AND FROM THE EXTERNAL BLANKET
BY AN ALUMINUM SPHERICAL STRUCTURE.
BLANKET ENCLOSED BY OUTER ALUMINUM STRUCTURE.

NEUTRON FLUX EPITHERMAL SPECTRUM

COOLANT TEMP. CORE 1040 F
BLANKET 250 F

COOLANT PRESS. CORE 860 PSIA
BLANKET 30 PSIA

REACTOR VESSEL THICK ALUMINUM HOLLOW SPHERE 140 FT. DIA., 1 IN.
THICK.
INNER BONDED ALUMINA LINING.
REFLECTOR AND BLANKET ARE SPHERICAL ALUMINUM
STRUCTURES

CONTAINMENT STEEL SPHERE
BIOLOGICAL AND BLAST SHIELDS, CONCRETE, IRON,

REMARKS PLANT INCLUDES ON-SITE FUEL PROCESSING FACILITIES,

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CAVITY (GAS CORE) REACTORS. DOMESTIC

CD06

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MODIFIED FLUORIDE VOLATILITY PROCESS FOR CORE
MATERIAL AND CONVENTIONAL THOREX PROCESS FOR
BLANKET MATERIAL

REFERENCES

DESIGN AND EVALUATION OF A 1000 MWE CENTRAL
STATION POWER PLANT WITH A CIRCULATING FUEL
GASEOUS CORE REACTOR. A STUDY CARRIED OUT AS PART
OF THE FIRST GRADUATE NUCLEAR ENGINEERING DESIGN
SEMINAR, JUNE 15-AUG. 7, 1964
FG ARCELLA, OTHERS
TID-22225 /ND/

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BNWL-326

CAVITY (GAS CORE) REACTORS, DOMESTIC

CD07

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NAME/OWNER GLOW PLUG REACTOR

DESIGNER DOUGLAS AIRCRAFT CO.

PURPOSE SPACE PROPULSION

TYPE GASEOUS CORE REACTOR

CRITICAL PRELIMINARY DESIGN STUDY

COOLANT COOLANT-PROPELLANT GAS IS HYDROGEN

MODERATOR SEE REMARKS

FUEL MATERIAL URANIUM HEXAFLUORIDE /GASEOUS/

FUEL ASSEMBLY CORE CONSISTS OF INDIVIDUAL CONCENTRIC TUBES,
WITH GASEOUS FUEL IN THE INSIDE TUBES AND THE
COOLANT-PROPELLANT FLOWING THROUGH THE TUBE
ANNULI. TUBE WALL MATERIAL STUDIED WERE SAPPHIRE,
FUSED SILICA, AND MAGNESIA OPTICAL CRYSTALS. FUSED
SILICA WAS SELECTED FOR THE THERMAL STUDY.

REMARKS PARALLEL, CROSS-FLOW, AND COMBINATIONS WERE
STUDIED,
TUBES ARE COOLED REGENERATIVELY BY THE ENTERING
COOLANT-PROPELLANT GAS, WHICH THEN PASSES THROUGH
THE SURROUNDING MODERATOR-REFLECTOR, IS SEEDS,
AND IS DIRECTED PAST THE OUTSIDE TUBES WHERE IT
IS HEATED BY THERMAL RADIATION FROM THE FUEL TO
THE REQUIRED DISCHARGE TEMPERATURE.

REFERENCES CONCEPTUAL DESIGN OF THE GLOW PLUG GASEOUS CORE
REACTOR
FA ROSS, RJ HALL
NP-15906 /NOV. 15, 1963/

CAVITY (GAS CORE) REACTORS

FOREIGN

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CAVITY (GAS CORE) REACTORS, FOREIGN

CF01

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NAME/OWNER	GASEOUS CORE REACTOR EXPERIMENT/USSR
DESIGNER	USSR
OPERATOR	USSR
PURPOSE	EXPERIMENT, SPACE PROPULSION
TYPE	GASEOUS FUEL
CRITICAL	GROUND-BASED EXPERIMENT OPERATED
MODERATOR	BERYLLIUM /GRAPHITE REFLECTOR/
FUEL MATERIAL	URANIUM HEXAFLUORIDE, GASEOUS
FUEL CLADDING	FUEL CHANNELS ARE ALUMINUM
FUEL ENRICH.	90 PER CENT URANIUM-235
REMARKS	GROUND-BASED EXPERIMENT IS REPORTED TO BE IN OPERATION.
REFERENCES	<p>EXPERIMENTAL REACTOR WITH GASEOUS FISSIONABLE SUBSTANCE /URANIUM HEXAFLUORIDE/.</p> <p>IK KIKOIN, OTHERS</p> <p>SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY 9 /PART2/, 528-34 /1958/</p> <p>SOVIET EXPERIMENTAL URANIUM HEXAFLUORIDE REACTOR, REVIEW OF SOVIET LITERATURE, AID WORK ASSIGNMENT NO. 16.</p> <p>LIBRARY OF CONGRESS, AEROSPACE INF. DIV., WASHINGTON D. C.</p> <p>NP-12239 /OCTOBER 18, 1962/</p>

GAS COOLED REACTORS

DOMESTIC

DD

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BNWL-326

GAS COOLED REACTORS, DOMESTIC

DD01

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NAME/OWNER	GCRE-1 /GAS COOLED REACTOR EXPERIMENT-1//AEC
DESIGNER	AEROJET-GENERAL NUCLEONICS
OPERATOR	AEROJET-GENERAL NUCLEONICS
LOCATION	NATIONAL REACTOR TEST STATION /VRTS/ IDAHO
PURPOSE	POWER EXPERIMENT, MOBILE PLANT /SEE ML-1/
TYPE	GCR
POWER MWE(MWT)	0 2
CRITICAL	CRITICAL EXPERIMENT OPERATION 1960, DISCONTINUED 1962
COOLANT	NITROGEN
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE DISPERSED IN SS /CERMET FUEL/
FUEL GEOMETRY	CONCENTRIC CYLINDERS OR PLATES ALTERNATE PINS
FUEL CLADDING	SS
FUEL ASSEMBLY	TUBE PLATES ALTERNATE 19-PIN CLUSTERS
REMARKS	A SOLID-MODERATED EXPERIMENT MAY BE CONSTRUCTED. A SECOND FUEL ELEMENT DESIGN CONSISTED OF HIGHLY ENRICHED URANIUM DIOXIDE PELLETS CONTAINED IN A LONG TUBULAR CAN /PIN/, A 19-PIN HEXAGONAL CLUSTER FORMING AN ELEMENT. THE USE OF URANYL NITRATE INSTEAD OF URANIUM DIOXIDE IN THE CERMET MATRIX WAS ALSO STUDIED.
REFERENCES	ARMY GAS COOLED REACTOR SYSTEMS PROGRAM, GCRE-I HAZARDS SUMMARY REPORT. ADDENDUM III. AEROJET-GENERAL NUCLEONICS DD-28506 /ADD. 3/ /MAY 1960/ ARMY GAS COOLED REACTOR SYSTEMS PROGRAM, FINAL SUMMARY REPORT OF THE GAS COOLED REACTOR EXPERIMENT -1. AEROJET-GENERAL NUCLEONICS IDO-28598 /OCT. 1963/.

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GAS COOLED REACTORS. DOMESTIC

DD02

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NAME/OWNER GCRE-2 /GAS COOLED REACTOR EXPERIMENT-2//AEC

DESIGNER AEROJET-GENERAL NUCLEONICS

PURPOSE PROPOSED AS BACK-UP EXPERIMENT FOR GCRE-I

TYPE GCR, SOLID HOMOGENEOUS CORE

CRITICAL: REFERENCE DESIGN, DEVELOPMENT.

COOLANT NITROGEN

MODERATOR GRAPHITE

FUEL MATERIAL URANIUM CARBIDE OR URANIUM DIOXIDE DISPERSED IN GRAPHITE

FUEL GEOMETRY HEXAGONAL GRAPHITE ELEMENT

FUEL CLADDING SILICON CARBIDE COATING, NICKEL-BASE ALLOY CAN

FUEL ASSEMBLY HEXAGONAL FUELED GRAPHITE ELEMENT CONTAINING 19 COOLANT TUBES

REMARKS A SOLID-MODERATED EXPERIMENT MAY BE CONSTRUCTED.

REFERENCES CONCEPTUAL DESIGN AND FEASIBILITY STUDY FOR THE GAS COOLED REACTOR EXPERIMENT-II.
GA LINDENBERGER
IDO-25530 /REV./ /1959/

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GAS COOLED REACTORS. DOMESTIC

DD03

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NAME/OWNER	ML-1 /MOBILE LOW-POWER-1//AEC, ARMY
DESIGNER:	AEROJET-GENERAL NUCLEONICS
OPERATOR	US ARMY
LOCATION	NATIONAL REACTOR TEST STATION /NRTS/ IDAHO DEVELOPMENT AT FT. BELVOIR, VA.
PURPOSE	PROTOTYPE FOR FIELD POWER GENERATING UNIT.
TYPE	GCR, CLOSED CYCLE, PRESSURE TUBE. MOBILE.
POWER MWE(MWT)	330 KWE 3.3
CRITICAL:	1961. TRIAL POWER RUN OCT. 1962, POWER OPERATION 1963.
COOLANT	NITROGEN, LATER, AIR
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE AND URANIUM / BERYLLIUM OXIDE PELLETS
FUEL GEOMETRY	PINS 1.72 IN. OD./32 IN. LONG. ACTIVE LENGTH 22 IN
FUEL CLADDING	HASTELLOY-X 0.241 IN. OD. TUBES, 0.030 IN. THICK
FUEL ENRICH.	93 PER CENT U-235
FUEL ASSEMBLY	19-PIN BUNDLES. INNER 6 PINS. ENRICHED URANIUM DIOXIDE. OUTER 12, URANIUM DIOXIDE DILUTED WITH BERYLLIUM OXIDE. CENTRAL PIN IS VOID. ELEMENTS ARE INSULATED. 61 ELEMENT/CORE, CONTAINED IN PRESSURE TUBES
FUEL CHARGE	49 KG, U-235
BURNUP(REFUEL)	1ST CORE LIFETIME 3000 HRS,
NEUTRON FLUX	THERMAL AVE. 1.9×10^{12} FAST AVE. 1.7×10^{13}
CONTROL	BURNABLE POISON LINER IN EACH FUEL ELEMENT AND CONTROL BLADES.
COOLANT TEMP.	INLET 791 F OUTLET 1200 F

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GAS COOLED REACTORS. DOMESTIC

DD03

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COOLANT PRESS. INLET 313 PSIA OUTLET 289 PSIA

REACTOR VESSEL STEEL VESSEL 80 IN. HIGH/31 IN. DIA.

CONTAINMENT SHIELD TANK CONTAINING 2 PER CENT BORIC ACID
SOLUTION AROUND THE CORE, RADIAL SHIELDING
MATERIALS.

REMARKS REACTOR IS BASED ON GCRE R+D. PROGRAM WILL
PROCEED TO COMPLETION OF AN ENGINEERING TEST
PROGRAM, AND A SERVICE TEST MODEL ML-1A FOR FIELD
EVALUATION MAY BE PROCURED. AGN IS ALSO STUDYING
ADVANCED CONCEPTS-SEE HDMR.
THE AEC-ARMY NUCLEAR PROGRAM WILL BE DISCONTINUED,
WITH PHASE-OUT OF ML-1. POWER CONVERSION FUNDING
BY THE ARMY WILL CONTINUE. FINAL TERMINATION
TARGET IS JUNE 30, 1966.

REFERENCES ARMY GAS COOLED REACTOR SYSTEMS PROGRAM,
PRELIMINARY HAZARDS SUMMARY REPORT FOR THE ML-1
NUCLEAR POWER PLANT,
IDO-28537 /APRIL 1959/

ARMY GAS COOLED REACTOR SYSTEMS PROGRAM. THE ML-1
DESIGN REPORT,
IDO-28550 /MAY 1960/

ARMY GAS COOLED REACTOR SYSTEMS PROGRAM,
CONCEPTUAL DESIGN STUDY, 3000 KWE MOBILE NUCLEAR
POWER PLANT,
HC CARNEY, JR,
AGN-TM-383 /APRIL 1961/

ML-1 CRITICAL EXPERIMENTS,
DA DINGEE, JW RAY
MND-C-2487 /P. 203-22/ /1961/

ARMY GAS COOLED SYSTEMS PROGRAM. FINAL HAZARDS
SUMMARY REPORT FOR THE ML-1 NUCLEAR POWER PLANT,
AEROJET-GENERAL NUCLEONICS
IDO-28560 /VOL. 1/ /NOVEMBER 1960/
IDO-28560 /VOL. 2, SUPPLEMENT 1/ /SEPTEMBER 1961/

JANUARY 1967

BNWL-326

GAS COOLED REACTORS. DOMESTIC

DD04

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NAME/OWNER	HDMR /HIGH DENSITY MODERATOR REACTOR/AEC-ARMY
DESIGNER	AEROJET-GENERAL NUCLEONICS
PURPOSE	MOBILE POWER PLANT STUDY FOR ARMY
TYPE	GCR, CLOSED CYCLE /REGENERATIVE BRAYTON CYCLE/.
POWER MWE(MWT)	500 KWE 3.34
CRITICAL	CONCEPTUAL DESIGN
MODERATOR	YTTRIUM HYDRIDE, NICKEL-BERYLLIUM OXIDE REFLECTOR
FUEL MATERIAL	URANIUM DIOXIDE PELLETS
FUEL GEOMETRY	PINS, 0.35 IN. DIA., 16-IN. ACTIVE LENGTH
FUEL CLADDING	HASTELLOY-X, 0.020 IN. THICK
FUEL ENRICH.	48 PER CENT U-235
FUEL ASSEMBLY	INDIVIDUAL PINS. 1157 TO CORE + 578 MOD. PINS /SOME PINS CONTAIN URANIUM OXIDE FUEL AND SOME CONTAIN YTTRIUM HYDRIDE.
FUEL CHARGE	108 KG. U-235
NEUTRON FLUX	THERMAL AVE. 1.4×10^4
CONTROL	DRUM-TYPE ELEMENTS IN REFLECTOR
COOLANT TEMP.	INLET 934 F OUTLET 1400 F
COOLANT PRESS.	500 PSIA
REACTOR VESSEL	SS PRESSURE VESSEL. TUNGSTEN TOP SHIELD PLUS TUNGSTEN IN THE LOWER ENDS OF THE FUEL PINS FOR SHIELDING. TUNGSTEN, SURROUNDING CORE RADially AS PRIMARY-GAMMA SHIELD.
CONTAINMENT	LEAD OUTSIDE THE TUNGSTEN SHIELD. OVERALL PACKAGE. 109.5 IN. LONG, 109 IN. WIDE, 90 IN. HIGH
REMARKS	CONCEPTUAL DESIGNS CONSIDERED WERE FOR VARIOUS THERMODYNAMIC CYCLES, MODERATORS, AND GAS COOLANTS HDMR EVOLVED AS THE OPTIMUM POWER PLANT.
REFERENCES	ARMY GAS COOLED REACTOR SYSTEMS PROGRAM, STUDY OF

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MOBILE GAS-COOLED NUCLEAR POWER PLANTS.
VOLUME I. PLANT DESCRIPTION.
VOLUME II. ANALYSIS
VOLUME III. APPENDIXES.
AEROJET-GENERAL NUCLEONICS
DO-28584 /VOLS. 1,2,3/ /1962/

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GAS COOLED REACTORS. DOMESTIC

DD05

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NAME/OWNER ARGONNE TUNGSTEN REACTOR/AEC

DESIGNER ARGONNE NATIONAL LABORATORY

PURPOSE ROCKET PROPULSION, FEASIBILITY STUDY.

TYPE GCR, UNMODERATED, FAST REACTOR

COOLANT GAS /HYDROGEN/

FUEL MATERIAL URANIUM DIOXIDE IN TUNGSTEN MATRIX

FUEL CLADDING TUNGSTEN

REMARKS DESIGN IS BEING CONSIDERED AS A BACKUP FOR
KIWI-NERVA FUELED GRAPHITE REACTORS. OPERATING
POWER LEVELS AND CORE TEMPERATURES ARE SIMILAR TO
KIWI. COMPONENT TESTING IS IN PROGRESS AND FUEL
DEVELOPMENT IS PROCEEDING, WITH TESTING IN
HYDROGEN AT TEMPERATURE AND PRESSURE IN FALL OF
1964. ZPR-9 /ZERO POWER REACTOR/ SAFETY ANALYSIS
HAS BEEN COMPLETED AND THE FACILITY IS IN
OPERATION.

REFERENCES REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT,
FEBRUARY 1964.
ARGONNE NATIONAL LAB.
ANL-6860 /MARCH 15, 1964/

JANUARY 1967

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GAS COOLED REACTORS, DOMESTIC

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NAME/OWNER CHEMONUCLEAR REACTOR STUDY-1/BNL
 DESIGNER BROOKHAVEN NATIONAL LABORATORY
 OPERATOR CONCEPTUAL DESIGN.
 PURPOSE CHEMONUCLEAR PRODUCTION AND POWER.
 TYPE GCR, CHEMONUCLEAR PLANT
 POWER MWE(MWT) 171 571
 CRITICAL CONCEPTUAL DESIGN
 COOLANT CARBON DIOXIDE
 MODERATOR GRAPHITE, GRAPHITE AXIAL AND RADIAL REFLECTORS.
 FUEL MATERIAL URANIUM DIOXIDE DISPERSED IN ALUMINUM FOIL,
 FUEL GEOMETRY FOIL
 FUEL CLADDING NONE
 FUEL ENRICH. 93 PER CENT U-235
 FUEL ASSEMBLY FOIL SPACED BY A SYSTEM OF SCREENING AND ROD-
 SPACERS COMPOSED OF SAP. CORE IS 19 FT. DIA.,
 19 FT. HIGH
 FUEL CHARGE 559 KG. U-235
 BURNUP(REFUEL) 50,000 MWD/TON U /45 DAYS/
 CONTROL POISON RODS INSERTED AXIALLY
 COOLANT TEMP. 650 F
 COOLANT PRESS. 500 PSI
 REACTOR VESSEL SPHERICAL, 33 FT. DIA.
 REMARKS CONCEPT FOR THE USE OF FISSION-FRAGMENT ENERGY TO
 SUPPLY THE HEAT OF REACTION TO CRACK CARBON
 DIOXIDE TO CARBON MONOXIDE. CHEMICAL OUTPUT OF THE
 REACTOR WOULD BE 1220 TONS OF CARBON DIOXIDE PER
 DAY, USING 129 MW OF THE TOTAL REACTOR POWER OF
 700 MW.
 REFERENCES DESIGN OF AN EXTERNALLY MODERATED, FIXED-FUEL

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CHEMONUCLEAR REACTOR.

DA GOELLNER

AMERICAN NUCLEAR SOC. TRANS. 5/2/, 436 /NOV. 1962/

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GAS COOLED REACTORS. DOMESTIC

DD07

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NAME/OWNER	CHEMONUCLEAR REACTOR STUDY-2/BNL
DESIGNER	BROOKHAVEN NATIONAL LABORATORY
PURPOSE	OZONE GENERATION.
TYPE	GCR, CHEMONUCLEAR REACTOR
POWER MWE(MWT)	39
CRITICAL	CONCEPTUAL DESIGN
COOLANT	OXYGEN GAS FROM AIR SEPARATION PLANT
MODERATOR	GRAPHITE, GRAPHITE REFLECTOR
FUEL MATERIAL	URANIUM DISPERSED IN PALLADIUM FOIL, 2.5 MICRONS THICK
FUEL ENRICH.	93.5 PER CENT U-235
FUEL ASSEMBLY	HONEYCOMB CONFIGURATION IN EACH SUBASSEMBLY, WHICH IS 3 IN./3 IN. WITH 0.04 IN. WALL THICKNESS. ALUMINUM STRUCTURAL MATERIAL.
FUEL CHARGE	100 KG. U-235
BURNUP(REFUEL)	CORE OPERATION 635 FULL-POWER DAYS
CONTROL	ABSORBING RODS, AXIAL INSERTION
COOLANT TEMP.	INLET -4 F OUTLET 32 F
COOLANT PRESS.	300 PSIG
REMARKS	GAS-PHASE OZONE PROCESS USES FISSION FRAGMENT ENERGY FOR GENERATING OZONE FROM OXYGEN, THE OXYGEN STREAM ACTS AS COOLANT, CHEMICAL REACTANT, AND PROCESS MEDIUM.
REFERENCES	DESIGN AND ECONOMIC STUDY OF A GAS-PHASE CHEMONUCLEAR OZONE PROCESS. M BELLER, OTHERS BNL-8281 /1964/ NUCLEAR APPLICATIONS 1, 322-6 /AUG. 1965/

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GAS COOLED REACTORS. DOMESTIC

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NAME/OWNER EBOR /EXPERIMENTAL BERYLLIUM OXIDE REACTOR//AEC
 DESIGNER GENERAL DYNAMICS CORPORATION
 OPERATOR GENERAL DYNAMICS, TEST OPERATION
 LOCATION NATIONAL REACTOR TEST STATION /NRTS/ IDAHO
 PURPOSE PROTOTYPE
 TYPE GCR, DIRECT CYCLE
 POWER MWE(MWT) 0 10
 CRITICAL 1963, POWER OPERATION 1965,
 COOLANT HELIUM
 MODERATOR BERYLLIUM OXIDE
 FUEL MATERIAL URANIUM DIOXIDE/BERYLLIUM OXIDE PELLETS, 0.33 IN,
 DIA./0.43 IN. LONG,
 FUEL GEOMETRY PINS, ACTIVE LENGTH 76 IN.
 FUEL CLADDING HASTELLOY-X TUBES 0.020 IN, WALL THICKNESS
 FUEL ENRICH. 70 PER CENT U-235
 FUEL ASSEMBLY 19-PIN ELEMENT, EACH CORE ELEMENT IS A STACK OF
 BERYLLIUM OXIDE SQUARE-ANNULAR BLOCKS WITH PINS
 INSERTED INSIDE THE CORE ELEMENT LINER, THE
 CENTER PIN CONTAINS ONLY BERYLLIUM OXIDE,
 36 CORE ELEMENTS, IN SHROUD TUBES IN THE
 BERYLLIUM OXIDE MODERATOR BLOCKS,
 FUEL CHARGE 100 KG. U-235
 BURNUP(REFUEL) 100,000 MWD/T
 NEUTRON FLUX THERMAL AVE. 4.8×10^{12}
 FAST AVE. 3.1×10^{13}
 CONTROL CRUCIFORM RODS, BURNABLE POISON
 COOLANT TEMP. INLET 750 F OUTLET 1300 F
 COOLANT PRESS. 1120 PSIA
 REACTOR VESSEL LOW ALLOY STEEL CYLINDRICAL SHELL 34 FT. HIGH,

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13 FT. OD., 5 1/4 IN. THICK

CONTAINMENT

REACTOR IS LOCATED IN A VAULT WITH CONCRETE WALLS
AND BOTTOM, COVERED WITH REMOVABLE CONCRETE SLABS.

REMARKS

LARGER CORE AND TURBOMACHINERY MAY BE INSTALLED
LATER. THERE IS NO CONTAINMENT VESSEL. CONTRACT
HAS BEEN EXTENDED TO COVER LAND-BASED ELECTRICITY
GENERATION. THE CONCEPT IS NO LONGER BEING
CONSIDERED WAY WITHIN THE MGCR PROGRAM, BUT
CURRENTLY IS SPONSORED BY AEC-S DIVISION OF
REACTOR DEVELOPMENT.

REFERENCES

MARITIME GAS COOLED REACTOR PROGRAM. MGCR
PROTOTYPE PRELIMINARY DESIGN. VOL. I.
GENERAL DYNAMICS
GA-1612 /VOL. I/ /DECEMBER 1960/

THERMAL DESIGN OF THE MGCR CORE,
JT ROGERS, R KATZ
GAMD-1542 /AUGUST 4, 1960/

MARITIME GAS COOLED REACTOR PROGRAM. A REVIEW OF
THE MARITIME GAS COOLED REACTOR PROGRAM.
KA TRICKETT
GA-2603 /DECEMBER 1961/

THE EXPERIMENTAL BERYLLIUM OXIDE REACTOR.
WC MOORE
ASME PREPRINT 61-WA-225 /1961/

EXPERIMENTAL BASES FOR THE DESIGN OF EBOR,
WC MOORE
POWER REACTOR EXPERIMENTS, VOL. 1, P. 79-101
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1962

MGCR AS A LAND BASED ELECTRIC PLANT.
F DE HOFFMANN, WT FURGERSON
GA-1516 /SEPT. 6, 1960/

JANUARY 1967

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GAS COOLED REACTORS. DOMESTIC

DD09

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NAME/OWNER	HTGR /HIGH TEMP. GCR/PHILADELPHIA ELECTRIC CO. PEACH BOTTOM REACTOR	
DESIGNER	GENERAL DYNAMICS CORPORATION	
OPERATOR	PHILADELPHIA ELECTRIC COMPANY	
LOCATION	PEACH BOTTOM, PENNA.	
PURPOSE	POWER PROTOTYPE	
TYPE	GCR, HIGH TEMPERATURE.	
POWER MWE(MWT)	40	115
CRITICAL	FUEL LOADING FEB. 1966, CRITICAL MARCH 1966.	
COOLANT	HELIUM	
MODERATOR	GRAPHITE, GRAPHITE REFLECTOR	
FUEL MATERIAL	URANIUM/THORIUM CARBIDE DISPERSED IN GRAPHITE, PELLETS	
FUEL GEOMETRY	ROD ACTIVE LENGTH 7.5 FT.	
FUEL CLADDING	PELLETS ARE CARBON COATED, GRAPHITE CAN, GRAPHITE SLEEVE.	
FUEL ENRICH.	93 PER CENT U-235	
FUEL ASSEMBLY	VENTED FUEL ELEMENT, FUEL COMPACT IN GRAPHITE SLEEVE, UPPER AND LOWER REFLECTOR SECTIONS, TOTAL LENGTH 12 FT. 804 FUEL ELEMENTS CORE, CLOSE-PACKED	
FUEL CHARGE	220 KG. URANIUM + 1450 KG. THORIUM	
SPECIFIC POWER	AVE. 800 KW/KG U-235	
BURNUP(REFUEL)	75,000 MWD/T URANIUM + THORIUM	/80 PERCENT PLANT LOAD, 36 MONTHS
NEUTRON FLUX	THERMAL AVE. 4×10^{13}	
CONTROL	RODS, BOTTOM MOUNTED	
COOLANT TEMP.	INLET 660 F	OUTLET 1380 F
REACTOR VESSEL	CARBON STEEL 14 FT. ID. / 37 FT. HIGH. WALL	

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THICKNESS 2 1/2 IN.

REMARKS

A THREE-YEAR DEVELOPMENT PROGRAM ON THE HTGR CONCEPT IS BEING CONDUCTED BY GD FOR ESADA /NEW YORK/. ADVANCED REACTOR DEVELOPMENT ASSOCIATES /ARDA/ HAS CONTRACTED WITH GENERAL DYNAMICS TO STUDY A 250 MW/E/ HTGR. MEMBERS OF OF ARDA ARE WESTERN UTILITY GROUPS. A 1000 MWE ADVANCED REACTOR PLANT IS BEING STUDIED /SEE TARGET/

REFERENCES

HTGR-UNDERLYING PRINCIPLES AND DESIGN.
P FORTESCU, OTHERS
NUCLEONICS 18, 86-90 /JANUARY 1960/

THE HTGR, AN ADVANCED HIGH TEMPERATURE GAS COOLED GRAPHITE MODERATED REACTOR.
CL RICKARD
PROC. SYMP. ON GAS COOLED REACTORS, PHILADELPHIA, FEBRUARY 1960, FRANKLIN INSTITUTE, /1960/

APPLICATION OF PHILADELPHIA ELECTRIC COMPANY FOR CONSTRUCTION PERMIT AND CLASS 104 LICENSE, PEACH BOTTOM ATOMIC POWER STATION. PART A. GENERAL INFORMATION, PART B.
PRELIMINARY HAZARDS SUMMARY REPORT, VOLUME I. PLANT DESCRIPTION AND SAFEGUARDS ANALYSIS, VOLUME II.
SITE AND ENVIRONMENTAL INFORMATION.
PHILADELPHIA ELECTRIC COMPANY
NP-9115 /JULY 1960/

GAS COOLED REACTORS.
POWER REACTOR TECHNOLOGY 5, 60-70 /JUNE 1962/

STATUS OF THE HIGH TEMPERATURE GAS-COOLED REACTOR.
T LE CLAIR
POWER APP. AND SYSTEMS NO. 62, P. 371-75 /OCTOBER 1962/

HIGH TEMPERATURE GAS-COOLED REACTORS,
F DE JOFFMANN, CL RICKARD
THIRD U. N. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY, GENEVA 1964, A/CONF.28/P/213

JANUARY 1967

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GAS COOLED REACTORS. DOMESTIC

DD10

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NAME/OWNER	FORT ST. VRAIN NUCLEAR STATION/PSC, COLORADO COLORADO HTGR
DESIGNER	GENERAL DYNAMICS CORPORATION
OPERATOR	PUBLIC SERVICE CO. OF COLORADO
LOCATION	PLATTEVILLE, COLORADO, NORTH OF DENVER
PURPOSE	POWER
TYPE	GCR, HIGH TEMPERATURE
POWER MWE(MWT)	330
CRITICAL	TARGET 1971
COOLANT	HELIUM
MODERATOR	GRAPHITE
FUEL MATERIAL	URANIUM/THORIUM CARBIDE IN GRAPHITE PARTICLES, COATED
FUEL GEOMETRY	CYLINDERS 20 FT. LONG/4.5 IN. DIA. NON-VENTED.
FUEL ASSEMBLY	SINGLE GRAPHITE ELEMENT MORE THAN 2000 ELEMENTS/CORE
BURNUP(REFUEL)	PARTIAL, 1-YEAR INTERVALS
CONTROL	RODS
REACTOR VESSEL	PRESTRESSED CONCRETE VESSEL HOUSES CORE, COOLANT GAS BLOWERS, STEAM GENERATORS.
REMARKS	THE PROPOSAL BY ROCHESTER G+E FOR THE HTGR WAS DROPPED, PSC OF COLORADO WILL BUILD THE PLANT IN ITS SYSTEM UNDER THE AEC ADVANCED CONVERTER PROGRAM, TARGET IS 1971. PLANNING INCLUDES A SECOND NUCLEAR UNIT AT THE SAME LOCATION WITH A CAPACITY OF 600-700 MWE, TO BE COMPLETED IN 1975 OR 1976
REFERENCES	NUCLEAR INDUSTRY DEC. 1965 P. 15 NEWS RELEASE

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GAS COOLED REACTORS, DOMESTIC

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NAME/OWNER	TARGET /THERMAL ADVANCED REACTOR GAS-COOLED EXPLOITING THORIUM// GD-AEC	
DESIGNER	GENERAL DYNAMICS CORPORATION	
PURPOSE	REFERENCE DESIGN, POWER, FUEL RECYCLE,	
TYPE	GCR, ADVANCED REACTOR.	
POWER MWE(MWT)	1000	2270
CRITICAL	REFERENCE DESIGN	
COOLANT	HELIUM	
MODERATOR	GRAPHITE AND BERYLLIUM OXIDE, GRAPHITE REFLECTOR	
FUEL MATERIAL	URANIUM/THORIUM CARBIDE COATED PELLETS /PYROCARBON COATING/	
FUEL GEOMETRY	CYLINDERS	
FUEL CLADDING	GRAPHITE SLEEVE, BERYLLIUM OXIDE SPINES, 4.53 IN. DIA./20 FT. LONG	
FUEL ENRICH.	HIGH	
FUEL ASSEMBLY	SINGLE ELEMENT EXTRUDED GRAPHITE BODY WITH FUEL PARTICLES LOOSELY PACKED IN COLUMNS WITHIN THE BODY OF THE ELEMENT, AND BERYLLIUM OXIDE AS AN ELEMENT SPINE MATERIAL, AND AN INTERNAL FISSION TRAP ASSEMBLY. 5,489 ELEMENTS.	
FUEL CHARGE	2374 KG. U-235, 86,330 KG. THORIUM	
BURNUP(REFUEL)	6-YEAR FUEL LIFE	/BATCH 1/6 PER YEAR/
CONTROL	RODS IN GRAPHITE GUIDE TUBES.	
COOLANT TEMP.	INLET 720 F	OUTLET 1470 F
COOLANT PRESS.	INLET 450 PSIA	
REACTOR VESSEL	PRESTRESSED CONCRETE HEXAGONAL VESSEL, INNER CYLINDRICAL DIA. 56 FT. 6 IN. / 40 FT. HIGH. INNER SS INSULATION, NEXT MILD STEEL CONCRETE LINER, COOLING COILS WITH WATER CIRCULATION, AND CONCRETE IN DIRECT CONTACT WITH LINER AND COOLING COILS.	

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CONTAINMENT A SECONDARY, CONVENTIONAL, LARGE LOW-PRESSURE
CONTAINMENT STRUCTURE HAS BEEN EXAMINED. THE
PRE-STRESSED CONCRETE REACTOR STRUCTURE, AS PER
THE REFERENCE DESIGN, IS LOCATED WITHIN A METAL
LEAK COLLECTOR WITHIN A CONVENTIONAL BUILDING.

REMARKS PLANT DESIGN AND DEVELOPMENT, UNDER CONTRACT TO
AEC, IS BASED ON HTGR CONCEPT. GAS COOLING FOR A
FAST REACTOR HAS BEEN REPORTED AT THE 3RD GENEVA
CONFERENCE, CONCEPT IS UNDER INVESTIGATION AT
GEN. DYNAMICS. SEE HELIUM COOLED FAST REACTOR,
DD-27.

REFERENCES A CONCEPTUAL DESIGN OF A 1000-MWE HIGH
TEMPERATURE GAS-COOLED REACTOR.
RM FRYER
ANS TRANSACTIONS, JUNE 1964. ABSTRACT.

DESIGN STUDY REPORT FOR TARGET, A 1000-MWE HIGH
TEMPERATURE GAS-COOLED REACTOR.
GENERAL ATOMICS DIV., GENERAL DYNAMICS CORP.
GA-4706 /NOV. 1964/

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GAS COOLED REACTORS, DOMESTIC

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NAME/OWNER HTRE-3 /HEAT TRANSFER REACTOR EXPERIMENT-3//AEC-
USAF

DESIGNER GENERAL ELECTRIC COMPANY

OPERATOR GENERAL ELECTRIC COMPANY

LOCATION NATIONAL REACTOR TEST STATION /NRTS/ IDAHO

PURPOSE AIRCRAFT PROPULSION EXPERIMENT

TYPE GCR, DIRECT CYCLE, HORIZONTAL CONFIGURATION.

POWER MWE(MWT) 0 32

CRITICAL HTRE-3 1958, POWER TESTS 1960-1961

COOLANT AIR /SEE REMARKS/

MODERATOR ZIRCONIUM HYDRIDE /SEE REMARKS/

FUEL MATERIAL URANIUM DIOXIDE IN NICKEL-CHROMIUM MATRIX

FUEL GEOMETRY ROD

FUEL CLADDING NICKEL-CHROMIUM ALLOY

FUEL ENRICH. 93.4 PER CENT U-235

FUEL ASSEMBLY FUEL-MODERATOR UNIT, SINGLE FUEL CARTRIDGE
150 UNITS/CORE

REMARKS THE SERIES HAS INVOLVED 2 REACTOR CONCEPTS, WATER-MODERATED AND ZIRCONIUM-HYDRIDE MODERATED REACTORS. HTRE-1 WAS WATER MODERATED AND THE CORE STRUCTURE WATER COOLED. HTRE-2 WAS A MECHANICALLY MODIFIED HTRE-1. HTRE-3 HAD SIMILAR CONFIGURATION BUT WAS MODERATED WITH SOLID ZIRCONIUM HYDRIDE AND THE CORE STRUCTURE WAS AIR-COOLED. THE REACTOR WAS TESTED WITH 2 J-47 ENGINES IN PARALLEL AT A 32.4 MW POWER LEVEL. THE CORE WAS COMPOSED OF AIR FLOW TUBES SURROUNDED BY A HEXAGONAL MODERATOR TUBE, EACH FLOW TUBE CONTAINING A SINGLE FUEL CARTRIDGE OF ENRICHED URANIUM DIOXIDE IN A NICKEL-CHROMIUM MATRIX. THE REACTOR OPERATED IN A HORIZONTAL POSITION. THE PROJECT HAS BEEN DISCONTINUED, BUT GE IS CARRYING OUT CONVERSION STUDIES TO A NUCLEAR MERCHANT SHIP POWER PLANT. PROJECT IS DESIGNATED 630-A.

REFERENCES ANP HTRE-S FULFILL TEST GOALS.

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G THORNTON, B BLUMBERG

NUCLEONICS 19, 45-51 /JANUARY 1961/

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GAS COOLED REACTORS, DOMESTIC

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NAME/OWNER 630-A NUCLEAR STEAM GENERATOR/GENERAL ELECTRIC CO.

DESIGNER GENERAL ELECTRIC COMPANY

LOCATION CRITICAL EXPERIMENT NRTS, IDAHO

PURPOSE SHIP PROPULSION

TYPE GCR
 CALANDRIA /MARK 5A/
 TUBE-TYPE /MARK 5B/

POWER MWE(MWT) 27,300 SHP 60.4 /MARK 5B/
 PLUS POWER FOR
 SHIP AUX. NEEDS

CRITICAL NUCLEAR MOCKUP 1962

COOLANT HELIUM

MODERATOR LIGHT WATER
 INNER REFLECTOR BERYLLIUM OXIDE
 OUTER REFLECTOR GRAPHITE

FUEL MATERIAL URANIUM DIOXIDE PELLET OR VIBRATORY COMPACTED POWDER

FUEL GEOMETRY ROD, 0.357 IN. OD., 42.0 IN. ACTIVE LENGTH
 LONG /4.184 IN. OD. STACKED IN CARTRIDGES. ACTIVE
 LENGTH 27.5 IN.

FUEL CLADDING INCOLOY, 0.015 IN. THICK /COLLAPSIBLE, OR SS STUDIED/

FUEL ENRICH. 6 PER CENT U-235

FUEL ASSEMBLY 27-ROD BUNDLE IN INCOLOY OR SS SHELL,
 216 ELEMENTS DISPERSED AROUND AND SUPPORTED
 FROM 91 MODERATOR TUBES EXTENDING DOWNWARD
 FROM SHIELD PLUG. HEXAGONAL PATTERN,

FUEL CHARGE 393 POUNDS U-235

SPECIFIC POWER 375 KW/KG

BURNUP(REFUEL) /15,000 HOURS/

CONTROL TOP-MOUNTED BORATED SS RODS, IN CENTER OF FUEL
 ELEMENTS AND BETWEEN ELEMENTS

COOLANT TEMP. INLET 553 F OUTLET 1200 F

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COOLANT PRESS. 830 PSIA

REACTOR VESSEL STEEL CYLINDER, FLANGED, 16 FT. 3 1/2 IN. HIGH

CONTAINMENT LOW-CARBON STEEL PRESSURE VESSEL ENCLOSING ENTIRE
 REACTOR - SHIELD PLUG, BOILER, PRESSURE VESSEL,
 GAS CIRCULATORS, MODERATOR COOLING SYSTEM, INNER
 SHIELD ASSEMBLY.
 12 1/2 FT. DIA., 39 FT. HIGH

REMARKS MARK 1, 2, AND 3 DESIGNS FOR A 27,300 SHP NUCLEAR
 STEAM GENERATOR WERE 85-CELL AIR-COOLED SYSTEMS
 USING NICKEL ALLOY CLAD CONCENTRIC FUEL RINGS AND
 FULLY ENRICHED FUEL. MARK-4 WAS A 55-CELL CLOSED
 CYCLE SYSTEM. MARK-5 IS EITHER A CALANDRIA TYPE
 /5A/ OR TUBE-TYPE /5B/ SYSTEM. THE REACTOR-SHIELD-
 PLUG ASSEMBLY IS THE INTEGRAL UNIT.

REFERENCES 630A MARITIME NUCLEAR STEAM GENERATOR SCOPING
 STUDY.
 GENERAL ELECTRIC CO., FLIGHT PROPULSION LABORATORY
 GEMP-108 /DECEMBER 1961/

630A MARITIME NUCLEAR STEAM GENERATOR. PROGRESS
 REPORT NO. 4.
 GENERAL ELECTRIC CO., FLIGHT PROPULSION LABORATORY
 GEMP-175 /JANUARY 31, 1963/

THE 630A CRITICAL EXPERIMENT. DESCRIPTION AND
 EXPERIMENTAL RESULTS.
 GD PINCOCK, RE WOOD
 TRANS. AMERICAN NUCLEAR SOC. 6/1/, 85-6 JUNE 1963/

630A MARITIME NUCLEAR STEAM GENERATOR SCOPING
 STUDY. SUMMARY REPORT.
 GENERAL ELECTRIC CO., FLIGHT PROP. LAB. DEPT.
 GEMP-107 /1962/

DESCRIPTION OF A 10,000 SHP 630A MARITIME NUCLEAR
 STEAM GENERATOR.
 GENERAL ELECTRIC CO., ADV. TECHNOLOGY SERVICES
 GEMP-239 /SEPT. 30, 1963/

THE 630A MARINE REACTOR.
 NUCLEAR ENG. 9. 50-53 /FEB. 1964/

630A-MARITIME NUCLEAR STEAM GENERATOR,
 STATUS REPORT NO. 1
 GENERAL ELECTRIC CO., ADV. TECHNOLOGY SERVICES

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GEMP-231 /SEPT, 12, 1963/

630A MARK-5 MARITIME NUCLEAR STEAM GENERATOR
STATUS REPORT

GEMP-342 /FEB, 26, 1965/

630A MARK-4 MARITIME NUCLEAR STEAM GENERATOR
SUMMARY REPORT

GEMP-341 /FEB, 26, 1965/

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GAS COOLED REACTORS, DOMESTIC

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NAME/OWNER	GCHWR /GAS COOLED HEAVY WATER-MODERATED REACTOR/ EAST COAST, FLORIDA WEST COAST NUCLEAR GROUP	
DESIGNER	GENERAL NUCLEAR ENGINEERING CORPORATION	
OPERATOR	TAMPA ELECTRIC CO., FLORIDA POWER CORP.	
LOCATION	POLK COUNTY, FLORIDA	
PURPOSE	POWER PROTOTYPE	
TYPE	GCR, VERTICAL PRESSURE TUBE	
POWER MWE(MWT)	50	153.4
CRITICAL	PROJECT DROPPED IN JUNE 1961	
COOLANT	CARBON DIOXIDE	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE IN BERYLLIUM MATRIX, PELLETS 0.500 IN. DIA.	
FUEL GEOMETRY	ROD	
FUEL CLADDING	SS 0.015 IN. THICK /BERYLLIUM CLADDING STUDIED/	
FUEL ENRICH.	2.05 PER CENT U-235	
FUEL ASSEMBLY	19-ROD CLUSTER ASSEMBLIES IN VERTICAL PRESSURE TUBES, 6-12 BUNDLES/PRESSURE TUBE 208 PRESSURE TUBES /ZIRCALOY-INSULATED/	
FUEL CHARGE	20.3 SHORT TONS URANIUM DIOXIDE	
BURNUP(REFUEL)	10,000 MWD/TON U	
CONTROL	CONTROL RODS, HORIZONTAL BLADES	
COOLANT TEMP.	INLET 550 F	OUTLET 1050 F
COOLANT PRESS.	500 PSI	
REACTOR VESSEL	SS PRESSURE VESSEL 0.75 IN. THICK/13 FT. OD. /24 FT. HIGH	
CONTAINMENT	STEEL, CYLINDRICAL, 118.5 FT. HIGH/87 FT. DIA.	
REMARKS	NEW PROPOSALS FOR STUDY INCLUDE A HEAVY-WATER,	

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NATURAL URANIUM REACTOR, WHICH WAS REFUSED BY THE AEC. EVALUATION STUDY DONE BY GNEC AND AEPSC INCLUDED A HEAVY WATER-MODERATED GCR, COLD PRESSURE TUBE DESIGN FOR 1630 MWT AND 480 MWE. FUEL WOULD BE BERYLLIUM-CLAD URANIUM DIOXIDE, NATURAL OR SLIGHTLY ENRICHED, WITH A BURNUP OF ABOUT 5000 MWT/MTU.

REFERENCES

INTERIM REFERENCE DESIGN, GAS COOLED, HEAVY WATER MODERATED, PRESSURE TUBE REACTOR PROTOTYPE /GCPT/ GENERAL NUCLEAR ENG.
GNEC-74 /SEPTEMBER, 1958/

PRELIMINARY HAZARDS SUMMARY REPORT, VOL. II, DESCRIPTION OF REACTOR AND PLANT, FLORIDA WEST COAST NUCLEAR GROUP
GEH-24950 /DECEMBER 1959/

APPLICATION FOR USAEC LICENSES BY FLORIDA WEST COAST NUCLEAR GROUP,
PART A, GENERAL INFORMATION,
PART B, PRELIMINARY HAZARDS SUMMARY REPORT,
VOLUME 1, CHARACTERISTICS OF SITE AND ENVIRONMENT,
VOLUME 2, DESCRIPTION OF REACTOR AND PLANT,
VOLUME 3, HAZARDS EVALUATION,
AMERICAN ELEC. POWER SERVICE CORP., GENERAL NUCLEAR ENG,
NP-8251 /DECEMBER 7, 1959/

HEAVY WATER MODERATED REACTORS EVALUATION STUDY, AMERICAN ELECTRIC POWER SERVICE CORP., GEN. NUCLEAR ENG,
NP-12344 /VOLS. 1,2,3/ /OCT. 15, 1962/

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NAME/OWNER EGCR /EXPERIMENTAL GAS COOLED REACTOR//AEC
DESIGNER KAISER ENG./ACF INDUSTRIES
OPERATOR TENNESSEE VALLEY AUTHORITY
LOCATION OAK RIDGE, TENNESSEE
PURPOSE POWER AND EXPERIMENT
TYPE GCR
POWER MWE(MWT) 22 85
CRITICAL TERMINATED. SEE REMARKS
COOLANT HELIUM
MODERATOR GRAPHITE, VERTICAL CHANNELS.
FUEL MATERIAL URANIUM DIOXIDE HOLLOW CYLINDERS 3/4 IN. LONG
0.707 IN. OD. 36 PELLETS PER ROD + 2 MAGNESIA
PELLETS.
FUEL GEOMETRY ROD, ACTIVE LENGTH 27 IN.
FUEL CLADDING SS THIN-WALL TUBE 0.020 IN. WALL THICKNESS
FUEL ENRICH. 2.46 PER CENT U-235
FUEL ASSEMBLY 7 TUBES PER ASSEMBLY, GRAPHITE SLEEVE
1650 ASSEMBLIES/CORE
EACH FUEL CHANNEL CONTAINS 6 ASSEMBLIES.
FUEL CHARGE 12.23 TONS URANIUM
BURNUP(REFUEL) 10,000 MWD/TU BATCH, FUEL SHUFFLING
NEUTRON FLUX THERMAL AVE. 0.78x10 E+13
CONTROL SS-BORON CARBIDE RODS, TOP-MOUNTED
COOLANT TEMP. INLET 510 F OUTLET 1043 F
COOLANT PRESS. INLET 313.7 PSIA OUTLET 303.4 PSIA
REACTOR VESSEL CARBON STEEL VESSEL 20 FT. ID. / 45 FT. HIGH
PLATE 2 3/4 IN. THICK, SS INNER TEMPERATURE
BARRIER.
CONTAINMENT STEEL CYLINDER 114 FT. DIA. / 216 FT. HIGH, 147 FT.

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ABOVE-GRADE, WITH A STEEL VESSEL SURROUNDING THE
REACTOR COMPLEX,

REMARKS

CORE IS A VERTICAL CYLINDER OF MONOLITHIC GRAPHITE
AND CONTROL RODS. HELIUM COOLANT FLOW IS FROM
THE BOTTOM OF THE CORE TO THE TOP, WHERE IT ENTERS
TWO SEPARATE LOOPS EACH HAVING ITS OWN HEAT
EXCHANGER AND BLOWER. FUEL DEVELOPMENT PROGRAM
WILL INCLUDE WORK IN UC, SILICON CARBIDE COATINGS,
AND OTHER CERAMIC FUELS. A 750 MWE VERSION OF THE
PLANT HAS BEEN EVALUATED BY TVA, WESTINGHOUSE,
THE EGCR WILL BE TERMINATED, WITH APPROXIMATELY
57-MILLION EXPENDED TO DATE.

REFERENCES

EXPERIMENTAL GAS COOLED REACTOR PRELIMINARY
HAZARDS SUMMARY REPORT,
KAISER ENG.
ORO-196 /MAY 1959/

EXPERIMENTAL GAS COOLED REACTOR PRELIMINARY
PROPOSAL,
KAISER ENG. AND ALLIS-CHALMERS MFG. CO.,
AECU-4701 /AUGUST 1959/

EGCR-DESCENDENT OF CALDER HALL
WF BANKS
NUCLEAR ENG. 6, 28-32 /JANUARY 1961/

EXPERIMENTAL GAS COOLED REACTOR FINAL HAZARDS
SUMMARY REPORT. VOLUME I. DESCRIPTION AND
HAZARDS EVALUATION,
ORO-586 /VOL. I/ /1962/

REVISIONS TO EXPERIMENTAL GAS COOLED REACTOR
FINAL HAZARDS SUMMARY REPORT.
VOL. 1. DESCRIPTION AND HAZARDS EVALUATION,
OAK RIDGE OPERATIONS OFFICE, AEC
ORO-586 /VOL. 1. SUPPL. 1/ /APRIL 1965/

AEC NEWS RELEASE J-4 /JAN. 7, 1966/

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NAME/OWNER	UHTREX /ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT/ AEC	
DESIGNER	LOS ALAMOS SCIENTIFIC LABORATORY	
OPERATOR	LOS ALAMOS SCIENTIFIC LABORATORY	
LOCATION	LOS ALAMOS, N. M.	
PURPOSE	POWER EXPERIMENT, EXTENSION OF TURRET	
TYPE	GCR, HIGH TEMPERATURE, REVOLVING CORE, UNCLAD FUEL	
POWER MWE(MWT)	3	
CRITICAL:	TARGET OCT. 1966	
COOLANT	HELIUM	
MODERATOR	GRAPHITE GRAPHITE REFLECTOR	
FUEL MATERIAL	URANIUM CARBIDE-GRAPHITE	
FUEL GEOMETRY	EXTRUDED HOLLOW CYLINDERS 1 IN. OD. BY 5.5 IN. LONG	
FUEL CLADDING	NONE PYROLYTIC GRAPHITE COATING	
FUEL ENRICH.	93 PER CENT U-235	
FUEL ASSEMBLY	FOUR FUELED CYLINDERS POSITIONED END-TO-END IN HORIZONTAL FUEL CHANNELS BORED RADially THROUGH THE HOLLOW GRAPHITE CORE CYLINDER. 312 RADIAL CHANNELS	
SPECIFIC POWER	450 W/G U-235	
BURNUP(REFUEL)	10-50 PER CENT	ON-LOAD 1-6 ELEMENTS DAILY SEE REMARKS
NEUTRON FLUX	THERMAL 2.4×10^{13}	
CONTROL	BORON CARBIDE AND BORON-SS RODS, ARTICULATED	
COOLANT TEMP.	INLET 1600 F	OUTLET 2400 F
COOLANT PRESS.	500 PSIA	

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REACTOR VESSEL SPHERICAL PRESSURE VESSEL
 CARBON STEEL 13.5 FT. OD., 1.75 IN. WALL.
 INTERNAL INSULATION.

CONTAINMENT CONCRETE STRUCTURE, STEEL-LINED,
 DIVIDED INTO SEPARATELY SHIELDED REACTOR CELL,
 WITH PRIMARY LOOP AND FUEL LOADING EQUIPMENT,
 FUEL-DISCHARGE ROOM, GAS CLEANUP ROOM, TWO
 GAS-CLEANUP PIPING ROOMS

REMARKS THE REACTOR CORE IS A VERTICAL GRAPHITE CYLINDER
 FABRICATED FROM 5 NESTED, CONCENTRIC, HOLLOW
 CYLINDERS. TAPERED PLUG IN CENTER OF CORE IS
 SLOTTED ON ONE SIDE TO RECEIVE SPENT FUEL ELEMENTS
 AND BORED AT THE BOTTOM FOR THE COOLANT INLET
 CHANNEL. CHANNELS RUN RADially FROM THE CENTER
 OF THE CORE TO ITS OUTSIDE EDGE, FUEL ELEMENTS
 BEING LOADED AT THE PERIPHERY AND DISCHARGED IN
 THE CENTER. THE CORE ROTATES ON ITS AXIS FOR
 REFUELING. HELIUM COOLANT ENTERS AT THE BOTTOM

REFERENCES TURRET, A HIGH TEMPERATURE GAS CYCLE REACTOR
 PROPOSAL.
 RP HAMMOND, OTHERS
 LA-2198 /JANUARY 23, 1958/

 A PRELIMINARY STUDY OF THE TURRET EXPERIMENT - AN
 OPERATING TEST OF UNCLAD FUEL AT HIGH TEMPERATURES
 RP HAMMOND, JP CODY
 LA-2303 /MARCH 1959/
 NUCLEONICS 17, 106-9 /DECEMBER 1959/

 ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT /UHTREX/
 HAZARD REPORT
 LOS ALAMOS SCIENTIFIC LAB.
 LA-2689 /MARCH 1962/

 UHTREX
 POWER REACTOR TECHNOLOGY 9, 51-63 /WINTER 1965-6/

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NAME/OWNER PROJECT ROVER/NUCLEAR ROCKET//AEC-NASA

DESIGNER LOS ALAMOS SCI. LAB./WESTINGHOUSE ELECTRIC CORP.

OPERATOR LOS ALAMOS SCI. LAB. /KIWI/

LOCATION JACKASS FLATS, NEVADA /NEVADA TEST SITE/

PURPOSE NUCLEAR ROCKET PROPULSION

TYPE GCR

POWER MWE(MWT) PHOEBUS 5000 MWT

CRITICAL KIWI 1959-1961
NRX 1964
NERVA FULL POWER TEST MARCH 3, 1966

COOLANT SEE REMARKS

MODERATOR GRAPHITE

FUEL MATERIAL URANIUM-GRAPHITE

REMARKS KIWI, NERVA, AND PHOEBUS ARE GRAPHITE SYSTEMS.
NERVA IS BASED ON THE KIWI DESIGN DEVELOPED AT LASL.
TESTING HAS BEEN IN PROGRESS SINCE JULY, 1959 AT JACKASS FLATS, NEVADA.
KIWI TESTS, COMPLETED.
NERVA-1 IN PROGRESS SEPT. 1966
PHOEBUS IN PROGRESS
1B, 1100 MWT SYSTEM, END OF 1966.
FULL-SIZE PHOEBUS 2A, EARLY 1968, 2B A YEAR LATER.
NERVA-2, 5000 MWT REACTOR, SCHEDULED FOR TESTING 1 OR 2 YEARS AFTER PHOEBUS 2A. FLIGHT-QUALIFIED ENGINE TEST TARGET IS 1975.
LOS ALAMOS WILL HANDLE FUEL FABRICATION FOR PHOENIX. WESTINGHOUSE THE DEVELOPMENT AND FUEL FABRICATION FOR 1100 MWT NERVAS.
LEWIS RESEARCH LAB WILL SUPPORT SNPO AND CONTRIBUTE TO NON-NUCLEAR ENGINE COMPONENT DEVELOPMENT.

REFERENCES NUCLEAR ROCKETS, LOS ALAMOS PROJECT ROVER, RE SCHREIBER
NUCLEONICS 16:70-2 /JULY 1958/

A REVIEW OF PROJECT ROVER

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RE SCHREIBER

IRE TRANS. NUCLEAR SCI. NS-9. 15-20 /JAN. 1962/

PHOEBUS MAY YIELD 268-POUND REACTOR.

FG MC GUIRE

MISSILES AND ROCKETS 12. 16-17 /APRIL 8, 1963/

REVIEW OF SOLID CORE NUCLEAR ROCKETS.

FC SCHWENK

IEEE TRANS. NUCLEAR SCIENCE NS-12 . 160-168

/FEB. 1965/

THE NERVA NUCLEAR ROCKET REACTOR PROGRAM.

WESTINGHOUSE ENG. 25. 66-75 /MAY 1965/

NUCLEAR INDUSTRY SEPT. 1966 P, 19-22

NEWS RELEASE

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NAME/OWNER NGE/NUCLEAR GAS ENGINE//AEC

DESIGNER OAK RIDGE NATIONAL LABORATORY

OPERATOR STUDY

PURPOSE SHIP PROPULSION

TYPE GCR, CLOSED CYCLE, DIRECT COUPLING TO
 RECIPROCATING ENGINE

POWER MWE(MWT) 1,5 OR 20,000 SHP 60

CRITICAL STUDY

COOLANT NITROGEN OR HELIUM

MODERATOR GRAPHITE

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL GEOMETRY RODS, 24 IN. LONG

FUEL CLADDING SS CAPSULES

FUEL ASSEMBLY 7 CAPSULES/ASSEMBLY IN FUEL CHANNELS.
 5 ASSEMBLIES/CHANNEL
 665 ASSEMBLIES / CORE

CONTROL RODS

REACTOR VESSEL CARBON STEEL, 14 FT. DIA./23 FT. HIGH/8 IN. THICK

CONTAINMENT CARBON STEEL 26 FT. OD./32 FT. HIGH/3/8 IN. THICK

REMARKS A PRELIMINARY STUDY HAS BEEN DONE OF A
 RECIPROCATING ENGINE COUPLED TO A GAS COOLED
 REACTOR, SIMILAR TO GCR-2 BUT WITH A SMALL CORE.

REFERENCES DESIGN CONSIDERATION FOR HIGH PRESSURE GAS COOLED
 REACTORS WITH SMALL CORES.
 OAK RIDGE NATIONAL LAB.
 ORNL-CF-58-7-55 /SEPTEMBER 1958/

 A NUCLEAR GAS ENGINE FOR MARINE PROPULSION.
 OAK RIDGE NATIONAL LAB.
 ORNL-CF-58-9-12 /SEPTEMBER 1958/

 PROC. 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM,
 AUGUST 1958.

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TID-7563 /JANUARY 1959/

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NAME/OWNER	PBRE /PEBBLE BED REACTOR EXPERIMENT/ /ORNL	
DESIGNER	OAK RIDGE NATIONAL LABORATORY	
PURPOSE	POWER EXPERIMENT	
TYPE	GCR, PEBBLE-BED	
CRITICAL	POSTPONED IN 1962	
COOLANT	HELIUM	
MODERATOR	GRAPHITE REFLECTOR	
FUEL MATERIAL	URANIUM/THORIUM OXIDE. OR URANIUM/THORIUM CARBIDE IN GRAPHITE	
FUEL GEOMETRY	SPHERES, 1.5 IN. OD.	
FUEL CLADDING	GRAPHITE COATING	
FUEL ENRICH.	2.91 PER CENT U-235	
FUEL ASSEMBLY	11,700 FUELED SPHERES/CORE	
FUEL CHARGE	17.2 KG. U-235	
SPECIFIC POWER	3000 KW/KG U-235	
BURNUP(REFUEL)	130,000 MWD/TON	EXPOSED FUEL RECYCLED TO TOP, ADDITION AND/OR REMOVAL BY GRAVITY FLOW AT POWER.
CONTROL	CONTROL BLADES, LOCATED IN REFLECTOR	
COOLANT TEMP.	INLET 550 F	OUTLET 1250 F
COOLANT PRESS.	500 PSIA	
REACTOR VESSEL	CORE, GRAPHITE REFLECTED CYLINDER 2 1/2 FT. DIA./ 4 FT. HIGH PRESSURE VESSEL, CARBON STEEL CYLINDER 9.5 FT. OD. 20 FT. HIGH/2.5 IN. THICK	
CONTAINMENT	SHIELDED COMPARTMENTS, SECONDARY CONTAINMENT BUILDING.	
REMARKS	BASIC DESIGN WAS CONCEIVED BY FARRINGTON DANIELS. A TWO-REGION THERMAL BREEDER DESIGN, STUDY PROJECT BY SANDERSON AND PORTER, WAS TURNED	

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OVER TO ORNL FOR RESEARCH AND DEVELOPMENT.
 SPHERICAL GRAPHITE FUEL PELLETS WERE EVALUATED.
 FIRST PHASE STUDY. PBRE, 5 MWT. SECOND PHASE,
 CONCEPTUAL DESIGN, 330 MWE, 800 MWT CENTRAL
 STATION. RADIAL FLOW, DOWNFLOW AND UPFLOW
 STUDIES, LARGE CORE WITH AXIAL FLOW SELECTED FOR
 DEVELOPMENT. PBRE PROPOSED FOR INSTALLATION IN
 HRE-2 FACILITY HAS BEEN POSTPONED.

REFERENCES

PRELIMINARY DESIGN OF A 10 MWT PEBBLE-BED
 REACTOR EXPERIMENT,
 OAK RIDGE NATIONAL LAB.
 CF-60-10-63 /NOVEMBER 1960/

DESIGN STUDY OF A PEBBLE-BED REACTOR POWER PLANT.
 AP FRAAS, OTHERS
 CF-60-12-5 /REV./ /MAY 1961/

CONCEPTUAL DESIGN OF THE PEBBLE-BED REACTOR
 EXPERIMENT,
 OAK RIDGE NATIONAL LAB.
 ORNL-RM-201 /MAY 1962/

DANIELS EXPERIMENTAL POWER PILE DESIGN PROPOSAL.
 MONN-188 /BOOKS 1 AND 2/

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NAME/OWNER	GCR STUDY, SPACE PROPULSION/THIOKOL	
DESIGNER	THIOKOL CHEMICAL CORPORATION	
PURPOSE	SPACE PROPULSION	
TYPE	GCR, PEBBLE-BED	
POWER MWE(MWT)	175	
COOLANT	HYDROGEN	
MODERATOR	GRAPHITE, LATERAL BERYLLIUM OXIDE REFLECTOR	
FUEL MATERIAL	FUELED GRAPHITE PELLETS, VARIABLE DIAMETERS	
FUEL GEOMETRY	PEBBLES	
FUEL ASSEMBLY	CORE STRUCTURE, CYLINDRICAL GRAPHITE SEPARATORS ENCLOSING FUEL PELLETS /COMPARTMENTED/, FUELED SPHERES HAVE DIFFERENT DIAMETERS FOR DIFFERENTIAL LOADING.	
CONTROL	ROTATING ELEMENTS, BORON-CONTAINING DRUMS IN REFLECTOR.	
COOLANT TEMP.	INLET 25 F	OUTLET 4200 F
COOLANT PRESS.	INLET 400 PSI	OUTLET 100 PSI
REACTOR VESSEL	GRAPHITE CYLINDER /CORE/ 5 FT. X 5 FT.	
REMARKS	A PARALLEL-PLATE CORE IS ALSO DISCUSSED. THE PEBBLE-BED CORE STRUCTURE CONSISTS OF CYLINDRICAL GRAPHITE SEPARATORS ENCLOSING THE FUEL PELLETS. DIFFERENTIAL RADIAL LOADING PREVENTS INCREASING POWER DENSITY AT CORE CENTER AND REDUCES FLOW THROUGH THE LATERAL REFLECTOR. THIOKOL HAS SET UP A UNIT FOR RESEARCH AND DEVELOPMENT IN NUCLEAR PROPULSION FOR SPACE AT PARSIPPANY-TROY HILLS, NEW JERSEY. THEY ARE PRIME CONTRACTORS IN AN AIR FORCE CONTRACT /WITH GM AND NUCLEAR DEVELOPMENT CORP./ FOR A NUCLEAR PROPULSION SYSTEM STUDY.	
REFERENCES	PEBBLE-BED REACTOR LOOKS OKAY FOR NUCLEAR SPACE VEHICLES. MM LEVOY, JJ NEWGARD SAE JOURNAL 68, 46-50 /JUNE 1960/ NUCLEAR SPACE VEHICLES USING PEBBLE-BED REACTORS.	

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MM LEVOY, JJ NEWGARD
NP-8586 /1960/

PEBBLE-BED NUCLEAR REACTORS FOR SPACE VEHICLE
PROPULSION,
MM LEVOY, JJ NEWGARD
AERO/SPACE ENGINEERING 19, 54-8 /APRIL 1960/

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NAME/OWNER	GCR-3 /GAS COOLED REACTOR-3/	
DESIGNER	OAK RIDGE NATIONAL LABORATORY TENNESSEE VALLEY AUTHORITY COMBUSTION ENGINEERING CORP. WESTINGHOUSE ELECTRIC CORP.	
PURPOSE	ADVANCED DESIGN STUDY	
TYPE	GCR, ADVANCED EGCR TYPE	
POWER MWE(MWT)	750	1908
CRITICAL	STUDY	
COOLANT	HELIUM	
MODERATOR	GRAPHITE, HEXAGONAL COLUMNS	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.97 IN. OD./0.74 IN. ID. 1 IN. LONG STACKED ON A THIN CERAMIC TUBE.	
FUEL GEOMETRY	RODS 18.9 FT. ACTIVE LENGTH /TWO RODS/	
FUEL CLADDING	SS 0.015 IN. THICK	
FUEL ENRICH.	3 PER CENT U-235	
FUEL ASSEMBLY	7-ROD CLUSTERS, GRAPHITE SLEEVES THROUGH THE MODERATOR BLOCKS. 1062 FUEL CHANNELS	
FUEL CHARGE	218,000 LB URANIUM DIOXIDE	
BURNUP(REFUEL)	20,000 MWD/T	4-STEP PER CORE LIFETIME.
CONTROL	RODS, TOP-MOUNTED	
COOLANT TEMP.	INLET 577 F.	OUTLET 1150 F
COOLANT PRESS.	420 PSIA	
REACTOR VESSEL	SPHERICAL STEEL VESSEL 52 FT. 6 IN. ID., 4 IN. THICK WALLS.	
CONTAINMENT	STEEL-LINED REINFORCED CONCRETE BUILDING.	
REMARKS	A STUDY TO EVALUATE THE FUTURE POTENTIAL OF GAS COOLED REACTORS OF THE EGCR TYPE.	
REFERENCES	THE ORNL GCR-3, A 750-MWE GAS-COOLED CLAD-FUEL	

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REACTOR POWER PLANT. A JOINT DESIGN STUDY,
M BENDER, WR GALL
ORNL-3353 /JAN, 28, 1963/

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GAS COOLED REACTORS. DOMESTIC

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NAME/OWNER	PBR /PEBBLE BED REACTOR//SANDERSON + PORTER	
DESIGNER	SANDERSON AND PORTER	
PURPOSE	POWER	
TYPE	GCR, PEBBLE-BED	
POWER MWE(MWT)	125	350
CRITICAL	CONCEPTUAL DESIGN	
COOLANT	HELIUM	
MODERATOR	GRAPHITE REFLECTOR	
FUEL MATERIAL	URANIUM/THORIUM DIOXIDE IN GRAPHITE, BLANKET THORIUM DIOXIDE IN GRAPHITE	
FUEL GEOMETRY	SPHERES 1 1/2 IN. DIA. BLANKET 3/4 IN. DIA.	
FUEL CLADDING	NONE	
FUEL ASSEMBLY	7 VERTICAL FUEL CHANNELS CONTAIN CORE ELEMENTS, BLANKET ELEMENTS IN ANNULAR RING FORMED BY THE CORE CHANNEL STRUCTURE AND THE THERMAL SHIELD. 228,600 SPHERES/CORE 2,370,000 SPHERES/BLANKET	
NEUTRON FLUX	THERMAL AVE. 2.2×10^{14}	
CONTROL	RODS, TOP-DRIVEN	
COOLANT TEMP.	INLET 550 F	OUTLET 1250 F
COOLANT PRESS.	965 PSIA	
REACTOR VESSEL	CARBON STEEL CYLINDER	
CONTAINMENT	CONTAINMENT VESSEL TO HOUSE PRIMARY SYSTEM, CONVENTIONAL STRUCTURE FOR SECONDARY SYSTEM.	
REMARKS	HELIUM FLOW IS DOWNWARD THROUGH CORE AND BLANKET IN PARALLEL. THE FUEL CHANNELS ARE 6 GRAPHITE CYLINDERS, BORED AXIALLY WITH AN OBOUND HOLE 31 IN./37 IN. FORMING A CENTRAL CHAMBER.	
REFERENCES	DESIGN AND FEASIBILITY STUDY OF A PEBBLE-BED REACTOR-STEAM POWER PLANT. PART I. PLANT DESIGN. SANDERSON + PORTER, ALCO PRODUCTS	

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NYO-8753 VOL. I /MAY 1958/

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NAME/OWNER	TORY/AEC
DESIGNER	UNIVERSITY OF CALIFORNIA RADIATION LABORATORY
OPERATOR	UNIVERSITY OF CALIFORNIA RADIATION LABORATORY
LOCATION	NEVADA TEST SITE
PURPOSE	PROJECT PLUTO /NUCLEAR RAMJET/ EXPERIMENT
TYPE	GCR, DIRECT CYCLE, HIGH TEMPERATURE, UNCLAD FUEL.
POWER MWE(MWT)	150 TORY-2C 600
CRITICAL	ZERO POWER, DEC. 1960 TORY-2C, 1964
COOLANT	AIR
MODERATOR	BERYLLIUM OXIDE, GRAPHITE REFLECTOR
FUEL MATERIAL	BERYLLIUM-URANIUM OXIDE
FUEL GEOMETRY	HEXAGONAL TUBES 4 IN. LONG
FUEL CLADDING	NONE
FUEL ENRICH.	HIGH
FUEL ASSEMBLY	HEXAGONAL BUNDLES CONTAINED IN UNFUELED BERYLLIUM OXIDE STRUCTURAL ELEMENT, WITH AIR-COOLED HASTELLOY TUBE AT EACH CORNER OF ELEMENT. APPROX. 100,000 FUEL ELEMENTS/CORE
CONTROL	GRAPHITE CYLINDERS WITH BORON STEEL /ROTATING/ AND LINEAR RODS
REMARKS	TORY-2-A-1 HAD A CYLINDRICAL CORE 45 INCHES LONG BY 32 INCHES DIAMETER. THE RAMJET CONSISTS OF AN INLET DIFFUSER, A SINGLE-PASS STRAIGHT-THROUGH HEAT EXCHANGER /THE REACTOR/, AND AN EXHAUST NOZZLE. THE PLUTO PROGRAM HAS BEEN DISCONTINUED /AUG. 1964/
REFERENCES	SUMMARY REPORT ON HIGH TEMPERATURE BERYLLIUM- OXIDE CRITICAL EXPERIMENTS. RG FINKE UCRL-6329 /1961/

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GAS COOLED REACTORS, DOMESTIC

DD24

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NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN
THE UNITED STATES AS OF DECEMBER 31, 1961,
TID-8200 /11TH REVISION/ /1964/

THE PLUTO PROGRAM.
HL REYNOLDS /LAWRENCE RADIATION LAB./
UCRL-6923 /MAY 17, 1962/

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GAS COOLED REACTORS, DOMESTIC

DD25

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NAME/OWNER GCR STUDY, PROCESS HEAT/US BU-MINES

DESIGNER UNITED STATES BUREAU OF MINES

PURPOSE PROCESS HEAT FOR GASIFICATION OF COAL

TYPE GCR, PEBBLE-BED, INDIRECT CYCLE

POWER MWE(MWT) 750

COOLANT HELIUM

MODERATOR GRAPHITE

FUEL GEOMETRY PEBBLES

REMARKS A NONNUCLEAR SYSTEM TO SERVE AS A PROTOTYPE HAS BEEN DESIGNED AND CONSTRUCTED. CONCEPT IS FOR A HELIUM-COOLED REACTOR /HELIUM ABOVE 1000 F/ TO HEAT STEAM. SUITABILITY OF HELIUM-GRAPHITE SUSPENSIONS AS REACTOR COOLANTS IS BEING INVESTIGATED.

REFERENCES HIGH TEMPERATURE SYSTEMS FOR NUCLEAR PROCESS HEAT,
JP MC GEE
TID-7564 /P. 305/ /1958/

INDIRECT CYCLE NUCLEAR REACTOR SYSTEM TO FURNISH
PROCESS HEAT,
RC DALZELL, JP MCGEE
CHEM. ENG. PROG. 55, SYMP. SERIES =22, 111-18
/1959/

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GAS COOLED REACTORS, DOMESTIC

DD26

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NAME/OWNER	GCR-MHD/WESTINGHOUSE	
DESIGNER	WESTINGHOUSE ELECTRIC CORPORATION	
PURPOSE	POWER-CONCEPT	
TYPE	GCR, NUCLEAR FUELED MHD PLANT. CLOSED CYCLE.	
POWER MWE(MWT)	600	
CRITICAL	STUDY	
COOLANT	HELIUM	
MODERATOR	GRAPHITE	
FUEL MATERIAL	URANIUM CARBIDE-GRAPHITE	
FUEL GEOMETRY	ANNULAR RODS	
FUEL CLADDING	NONE	
FUEL ENRICH.	SLIGHT	
FUEL ASSEMBLY	ANNULAR ELEMENTS POSITIONED IN FUEL CHANNELS	
BURNUP(REFUEL)	/ON-LOAD REFUELING/	
COOLANT TEMP.	INLET 1690 F	OUTLET 2500 F
COOLANT PRESS.	25-50 PSIA	
REACTOR VESSEL	CORE, RIGHT CYLINDER OF GRAPHITE MODERATOR AND REFLECTOR PIERCED BY VERTICAL FUEL CHANNELS.	
REMARKS	UTILIZATION OF FISSION PRODUCTS FROM UNCLAD FUEL FOR GAS IONIZATION. SYSTEM CONSISTS OF THE REACTOR, AN MHD GENERATOR, MHD COMPRESSOR, REGENERATOR, COOLER, POSSIBLY A D.C. TO A.C. CONVERTER.	
REFERENCES	MHD POWER GENERATION BY NONTHERMAL IONIZATION AND ITS APPLICATION TO NUCLEAR ENERGY CONVERSION. EJ STERNGLASS, OTHERS NUCLEAR ENERGY, MARCH 1963, P. 60-66.	

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GAS COOLED REACTORS. DOMESTIC

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NAME/OWNER GCR FAST REACTOR STUDY/GD
HELIUM COOLED FAST BREEDER

DESIGNER GENERAL DYNAMICS CORPORATION

PURPOSE POWER, POSSIBLY DESALINATION

TYPE GCR, FAST BREEDER

POWER MWE(MWT) 415 1093

CRITICAL REFERENCE DESIGN

COOLANT HELIUM /CARBON DIOXIDE STUDIED/

MODERATOR NONE

FUEL MATERIAL URANIUM/PLUTONIUM OXIDE PELLETS, CORED, 0.5 IN.
LONG.
RADIAL BLANKET URANIUM DIOXIDE

FUEL GEOMETRY ROD 46 IN. LONG
UPPER AND LOWER BLANKET SECTIONS EACH 18 IN.

FUEL CLADDING HASTELLOY CANS 0.44 IN. OD., 12.5 MILS THICK
SPACING BY RIBS

FUEL ASSEMBLY BUNDLES
100 RODS/BOX, ACTIVE LENGTH 116.5 CM.
213 BOXES, SQUARE PITCH
GRID-PLATE IS EGG-CRATE STRUCTURE

FUEL CHARGE 1770 KG. FISSILE

SPECIFIC POWER 0.62 MWT/KG FISSILE

BURNUP(REFUEL) 100,000 MWD/T

CONTROL MOTION OF POISON ELEMENTS, FUEL, OR BOTH

COOLANT TEMP. INLET 300 C OUTLET 600 C
SEE REMARKS

COOLANT PRESS. 1000 PSIA
SEE REMARKS

REACTOR VESSEL PRESTRESSED CONCRETE CYLINDER, FLAT ENDS.
INNER STEEL LINING FACED WITH INSULATING MATERIAL,
ADJACENT BUILT-IN WATER COILS. VESSEL CONTAINS
CORE, CIRCULATORS, STEAM GENERATORS, MAIN COOLANT

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DUCTING, ROD-DRIVE MECHANISMS.

CONTAINMENT CONCRETE-LINED PIT

REMARKS CARBON DIOXIDE COOLANT AND CARBIDE FUELS WERE ALSO STUDIED.
 REPRESENTATIVE DESIGNS INCLUDE A 463 MWE PLANT WITH HELIUM COOLANT, OXIDE FUEL, WORKING PRESSURE 1000 PSI, INLET 300 C AND OUTLET 596 C, AND A 1364 MWE PLANT WITH CARBON DIOXIDE COOLANT, CARBIDE FUEL, WORKING PRESSURE 2000 PSI, INLET 340 C AND OUTLET 615 C. STUDY UNDER AEC SPONSORSHIP. APPLICATION TO WATER DESALINATION IS CONSIDERED.

REFERENCES

GAS COOLING FOR FAST REACTORS.
 P. FORTESCUE, OTHERS
 3RD UN INTL. CONF. PEACEFUL USES ATOMIC ENERGY,
 GENEVA, 1964, A/CONF. 28/P 694

DEVELOPMENT OF THE GAS-COOLED FAST REACTOR CONCEPT
 P. FORTESCUE, R.T. SHANSTROM, H. FRENCH
 NUCLEONICS 23 /5/, 56-60 /MAY 1965/

STUDY OF A GAS-COOLED FAST BREEDER REACTOR,
 INITIAL STUDY, CORE DESIGN ANALYSIS AND SYSTEM
 DEVELOPMENT PROGRAM. FINAL SUMMARY REPORT,
 GENERAL ATOMIC DIV. GENERAL DYNAMICS
 GA-5537 /AUG. 15, 1964/

DEVELOPMENT OF THE GAS-COOLED FAST REACTOR CONCEPT
 P. FORTESCUE, RT SHANSTROM
 FAST REACTOR TECHNOLOGY, NATIONAL TOPICAL MEETING
 APRIL 26-28, 1965. AMERICAN NUCLEAR SOCIETY.
 ANS-100 /P.89-98/

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GAS COOLED REACTORS. DOMESTIC

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NAME/OWNER	MMPPR /MULTIPURPOSE MILITARY PORTABLE POWER REACTOR.
DESIGNER	AEROJET-GENERAL NUCLEONICS
PURPOSE	MILITARY POWER REQUIREMENTS.
TYPE	GCR, AIR OR SUPERHEATED STEAM COOLANT, PRESSURE TUBE, PORTABLE PLANT.
POWER MWE(MWT)	1
CRITICAL	DESIGN
COOLANT	AIR OR SUPERHEATED STEAM, SEE REMARKS
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE
FUEL GEOMETRY	PIN
FUEL CLADDING	HASTELLOY X
FUEL ENRICH.	MODERATE
FUEL ASSEMBLY	19-PIN BUNDLE
CONTROL	BLADES
COOLANT TEMP.	1000 F MAX. WITH BRAYTON CYCLE 1200 F
COOLANT PRESS.	500 PSI
REACTOR VESSEL	ALUMINUM TANK, 8 FT. DIA./8 FT. HIGH, OUTER LEAD SHIELDS TO FORM AN ANNULUS FOR CIRCULATION OF BORATED WATER.
CONTAINMENT	SHIELD TANKS, SAND BAGS.
REMARKS	A DUAL-LOOP PLANT UTILIZING THE LOEFFLER OR THE BRAYTON CYCLE, CONVENTIONAL SUPERHEATED-STEAM POWER-CONVERSION EQUIPMENT. A DIRECT-STEAM-CYCLE PLANT USES THE SAME GAS-COOLED REACTOR, BUT IS COOLED BY SUPERHEATED STEAM WHICH IS USED DIRECTLY AS THE TURBINE WORKING FLUID. PLANT IS DESIGNED FOR TRANSPORTATION TO REMOTE AREAS IN A TOTAL OF 25 PACKAGES.
REFERENCES	DESIGNED, THE PORTABLE POWER REACTOR.

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GAS COOLED REACTORS. DOMESTIC

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S. LUCHTER /AEROJET-GENERAL NUCLEONICS/
MECH. ENG. 87, 32-35 /JUNE 1965/

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GAS COOLED REACTORS. DOMESTIC

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NAME/OWNER GCR FAST REACTOR STUDY-1/ORNL
 DESIGNER OAK RIDGE NATIONAL LABORATORY
 PURPOSE POWER
 TYPE GCR, INDIRECT CYCLE, FAST REACTOR
 POWER MWE(MWT) 1080 2500
 CRITICAL CONCEPTUAL DESIGN
 COOLANT HELIUM
 MODERATOR STEEL REFLECTOR
 FUEL MATERIAL URANIUM/PLUTONIUM DIOXIDE
 BLANKET, DEPLETED URANIUM DIOXIDE
 FUEL GEOMETRY PIN 0.25 IN. DIA., 72 IN. LONG + 15 X 2 IN. AXIAL
 BLANKET,
 RADIAL BLANKET PINS 0.92 IN. DIA., 8.5 FT.
 LONG
 FUEL CLADDING SS
 FUEL ASSEMBLY CORE, 421-PIN BUNDLE, CYLINDRICAL STEEL ALLOY
 CONTAINER 9.763 IN. OD.
 154 ASSEMBLIES
 BLANKET, RADIAL, 9 IN. OD. -
 102 ASSEMBLIES
 BURNUP(REFUEL) SHUT DOWN
 CONTROL RODS
 COOLANT TEMP. INLET 500 F OUTLET 1150 F
 COOLANT PRESS. 1016 PSI
 REACTOR VESSEL PRESTRESSED CONCRETE SPHERE 44 FT. ID., 11 FT.
 WALL THICKNESS, LINED.
 CONTAINMENT REINFORCED CONCRETE CYLINDER 100 FT. ID., 154.5 FT
 HIGH, WALL THICKNESS 4.5 FT.
 REMARKS TWO SYSTEMS WERE STUDIED, HELIUM-COOLED INDIRECT
 CYCLE WITH CONVENTIONAL STEAM CYCLE, AND SULFUR
 DIOXIDE COOLED DIRECT CYCLE SYSTEM WITH A DIRECT
 RANKINE CYCLE /SEE DD30/.

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GAS COOLED REACTORS, DOMESTIC

DD29

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A CARBON DIOXIDE-COOLED SYSTEM WAS BRIEFLY
REVIEWED.

REFERENCES

GAS COOLED FAST REACTOR CONCEPTS.
OAK RIDGE NATIONAL LAB.
ORNL-3642 /SEPT. 1964/

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GAS COOLED REACTORS. DOMESTIC

DD30

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NAME/OWNER	GCR FAST REACTOR STUDY-2/ORNL
DESIGNER	OAK RIDGE NATIONAL LABORATORY
PURPOSE	POWER
TYPE	GCR, FAST REACTOR, DIRECT RANKINE CYCLE
POWER MWE(MWT)	3168
CRITICAL	CONCEPTUAL DESIGN
COOLANT	SULFUR DIOXIDE /SUPERCRITICAL/
MODERATOR	CYLINDRICAL STEEL REFLECTOR.
FUEL MATERIAL	CORE, URANIUM/PLUTONIUM DIOXIDE BLANKET, DEPLETED URANIUM DIOXIDE OXIDES COMPACTED BY VIBRATORY METHODS
FUEL GEOMETRY	PIN 72-IN. ACTIVE LENGTH + 15 X 2 IN. AXIAL BLANKET. RADIAL BLANKET LARGER DIA.
FUEL CLADDING	HASTELLOY-X SEAMLESS TUBING 1/4 IN. OD.
FUEL ASSEMBLY	CORE, 577-PIN ASSEMBLY, CYLINDRICAL CONTAINER 135 FUEL ASSEMBLIES 114 RADIAL BLANKET ASSEMBLIES
CONTROL	RODS, BOTTOM ENTRY
COOLANT TEMP.	OUTLET 910 F
COOLANT PRESS.	INLET 1350 PSIA OUTLET 1200 PSIA
REACTOR VESSEL	CORE VESSEL 17 FT. ID., 8 IN. WALL THICKNESS, CARBON STEEL CYLINDER. SS LINER ABOVE CORE. PRIMARY VESSEL MAY BE PRESTRESSED CONCRETE. ANNULAR SPACE BETWEEN CORE VESSEL AND PRIMARY /COOLANT/ VESSEL.
CONTAINMENT	SPHERICAL SHELL, ALL-METAL RECOMMENDED. CENTRAL SHELL HOUSING THE REACTOR IS CONNECTED TO 5 IDENTICAL SURROUNDING SHELLS /REGENERATOR- CONDENSER-PUMP SYSTEM/. EACH SHELL IS 80 FT. DIA. WITH WALLS ABOUT 1 3/8 IN. THICK. SHELLS ARE SEALED FROM THE REACTOR SHELL AND FROM EACH OTHER.
REMARKS	CORE COOLANT IS IN THE SUPERCRITICAL PHASE.

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REACTOR SUPPLIES 910 F, 1200 PSIA SUPERCRITICAL
SULFUR DIOXIDE TO TWO 500-MW TURBINE GENERATORS.
TURBINES EXHAUST THROUGH REGENERATORS TO SURFACE
CONDENSERS AND CONDENSED LIQUID IS PUMPED BACK TO
THE REACTOR THROUGH REGENERATORS WHICH PRE-HEAT
REACTOR FEED TO 234 F AND 800 PSI,
PRESSURE IS INCREASED BY A FEED PUMP TO 1405 PSIA
AT 238 F.

REFERENCES

GAS COOLED FAST REACTOR CONCEPTS
OAK RIDGE NATIONAL LAB.
ORNL-3642 /SEPT. 1964/

GAS COOLED REACTORS

FOREIGN

DF

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GAS COOLED REACTORS. FOREIGN

DF01

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NAME/OWNER HTGR /HIGH TEMP. GAS-COOLED REACTOR/AAEC, AUSTRALIA

DESIGNER AAEC-AUSTRALIA

PURPOSE POWER REACTOR STUDY

TYPE GCR, HIGH TEMPERATURE, PEBBLE-BED

POWER MWE(MWT) 500

CRITICAL FEASIBILITY STUDY

COOLANT CARBON DIOXIDE

MODERATOR BERYLLIUM OR BERYLLIUM OXIDE

FUEL MATERIAL /THORIUM-PLUTONIUM/ OXIDE-BERYLLIUM OXIDE PEBBLES
ABOUT 1 IN. DIA.
A PLUTONIUM/THORIUM/BERYLLIUM SYSTEM IS BEING
STUDIED.

FUEL GEOMETRY PEBBLES

FUEL CLADDING BERYLLIA COATING

FUEL ENRICH. FISSILE-FERTILE-MODERATOR RATIO 1-10-2000

SPECIFIC POWER 1-3 MW/KG FUEL

COOLANT TEMP. INLET 350 C OUTLET 700-800 C

COOLANT PRESS. 35 ATM. /515 PSI/

REMARKS SYSTEM INVESTIGATION, FUEL ELEMENTS STUDIES.
MOST PROMISING ELEMENTS INCORPORATE BERYLLIUM,
URANIUM, AND THORIUM. CERMET FUELS, BERYLLIUM
OXIDE MATRIX ELEMENTS ARE UNDERGOING IRRADIATION
STUDIES. CONCEPT DEVELOPMENT TARGET IS 1980

REFERENCES TENTH ANNUAL REPORT, 1961-1962
AUSTRALIAN ATOMIC ENERGY COMMISSION
1962

HIGH TEMPERATURE GAS-COOLED REACTOR FEASIBILITY
STUDY.
PP. 27-39

AUSTRALIAN ATOMIC ENERGY COMMISSION TWELFTH
ANNUAL REPORT, .
1963-64.

JANUARY 1967

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DF01

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THE AUSTRALIAN HIGH TEMPERATURE GAS-COOLED REACTOR
FEASIBILITY STUDY.

WH ROBERTS

J. NUCLEAR MATERIALS 14, 29-40 /1964/

PROC. 1ST. INTL. CONF. BERYLLIUM OXIDE, AUSTRALIA,
OCT. 1963

JANUARY 1967

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GAS COOLED REACTORS. FOREIGN

DF02

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NAME/OWNER BRAZILIAN POWER REACTOR/CEN, BRAZIL

DESIGNER NOT SELECTED

LOCATION PARATI, BRAZIL /MAMBUCABA RIVER/

PURPOSE POWER

TYPE GCR - NOT FIRM

POWER MWE(MWT) 150

REMARKS ON COMPLETION OF STUDY, CEN WILL INVITE PUBLIC
BIDS FOR CONSTRUCTION.

REFERENCES APPLIED ATOMICS JUNE 13, 1962, P. 8-9

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GAS COOLED REACTORS. FOREIGN

DF03

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NAME/OWNER CZECHOSLOVAKIA ATOMIC POWER STATION/CZECH.SOC.REP.
 DESIGNER USSR
 OPERATOR CZECH.SOC.REP.
 LOCATION BOHUNICE, CZECH.
 PURPOSE POWER
 TYPE GCR, HEAVY WATER MODERATED, PRESSURE TUBE /CALANDRIA/
 POWER MWE(MWT) 150 590
 CRITICAL TARGET 1970
 COOLANT CARBON DIOXIDE
 MODERATOR HEAVY WATER
 FUEL MATERIAL URANIUM
 FUEL GEOMETRY ROD 4 MM. DIA./4.0 M. LONG /WIRE/
 FUEL CLADDING MAGNESIUM-BERYLLIUM ALLOY 0.45 MM. THICK
 FUEL ENRICH. NATURAL
 FUEL ASSEMBLY CLUSTER OF THIN FUEL RODS SUSPENDED AT TOP, EACH CLUSTER IS IN A MAGNESIUM ALLOY SHIELD TUBE. 150-200 RODS/ELEMENT.
 FUEL CHARGE 25,400 KG. URANIUM
 SPECIFIC POWER 23.2 KW/KG URANIUM
 BURNUP(REFUEL) 3000 MWD/TON /CONTINUOUS/
 CONTROL RODS, SHIM-SAFETY AND REGULATING, GRAVITY DROP
 COOLANT TEMP. INLET 100 C OUTLET 425 C
 COOLANT PRESS. 60 ATM.
 REACTOR VESSEL STEEL VESSEL. IN IT IS MOUNTED AN ALUMINUM TANK CONTAINING THE MODERATOR WITH ALUMINUM TUBES CONTAINING FUEL ELEMENTS, AND FOR COOLANT CIRCULATION.
 REMARKS PLANS CALL FOR A 4-REACTOR STATION AT THIS SITE.

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DF03

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A SECOND 150 MWE STATION IS PLANNED FOR BANSKA
BYSTRIKA IN THE VAH VALLEY

REFERENCES

ROD FUEL ELEMENT FOR A GAS-COOLED HEAVY WATER
REACTOR

PI KHRISTENKO, OTHERS

SECOND UN, INTL- CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY 6, 370-78 /1958

A HEAVY WATER POWER REACTOR WITH GAS COOLING

AI ALIKHANDOV, OTHERS

J. NUCLEAR ENERGY II, VOL. 3, 77-82 /1956/

ENGINEERING AND ECONOMIC ASPECTS OF CONSTRUCTION
OF AN ATOMIC POWER STATION IN CZECHOSLOVAKIA
A SEVCICK

SECOND UN, INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY 8, 322-8 /1958/

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GAS COOLED REACTORS, FOREIGN

DF04

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NAME/OWNER	BETA/DANATOM, DENMARK	
DESIGNER	DANATOM-DENMARK	
PURPOSE	POWER	
TYPE	GCR	
POWER MWE(MWT)	175	574
CRITICAL	DESIGN STUDY	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE	
FUEL MATERIAL	NATURAL URANIUM	
FUEL GEOMETRY	ROD, 29.2 MM, DIA. /1.15IN./28.8 IN, LONG	
FUEL CLADDING	MAGNOX, FINNED,	
FUEL ASSEMBLY	RODS IN GRAPHITE SLEEVES, LOCATED IN VERTICAL COOLANT CHANNELS IN CYL. GRAPHITE STRUCTURE, 9 ELEMENTS / CHANNEL 3176 FUEL CHANNELS / CORE	
BURNUP(REFUEL)	3000-4500 MWD/T	
NEUTRON FLUX	THERMAL MAX, 3.26x10 E+13 THERMAL AVE, 1.74x10 E+13	
CONTROL	RODS, SAFETY AND SHIM, BORON-STEEL	
COOLANT TEMP.	INLET 190 C	OUTLET 380 C
COOLANT PRESS.	156.5 PSIA	
REACTOR VESSEL	PRESSURE VESSEL 68 FT, 8 1/2 IN, ID. SPHERE, LOW-C STEEL	
REMARKS	VERTICAL COOLANT CHANNELS ARE LOCATED WITHIN THE CYLINDRICAL GRAPHITE STRUCTURE, THE CARBON DIOXIDE FLOWING IN THE ANNULAR SPACE BETWEEN THE GRAPHITE SLEEVES AND THE FUEL RODS, AFTER PASSING THROUGH THE HEAT EXCHANGERS, THE COOLANT GAS IS RETURNED TO THE REACTOR,	
REFERENCES	BETA, A 175 MW GAS COOLED NUCLEAR REACTOR POWER STATION, A PRELIMINARY DESIGN STUDY,	

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DF04

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DANATOM

DANATOM-01-60 /MARCH 1960/

BETA, DANATOMS 175 MW DESIGN STUDY.

NUCLEAR ENG. 5, 264-5 /JUNE 1960/

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GAS COOLED REACTORS, FOREIGN

DF05

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NAME/OWNER	NEUBRANDENBERG STATION/EAST GERMANY
DESIGNER	USSR
OPERATOR	E GERMANY
LOCATION	NEUBRANDENBERG, EAST GERMANY
PURPOSE	POWER EXPERIMENT
TYPE	GCR, HEAVY WATER MODERATED, PRESSURE TUBE /CALANDRIA/
POWER MWE(MWT)	70 300
CRITICAL	1964
COOLANT	CARBON DIOXIDE
MODERATOR	HEAVY WATER
FUEL MATERIAL	URANIUM
FUEL ENRICH.	SLIGHT
REMARKS	NO RECENT INFORMATION. STATION REPORTEDLY TO BE EQUIPPED WITH TWO 70 MW/E/ REACTORS BY 1965.
REFERENCES	A HEAVY WATER, GAS COOLED REACTOR, AI ALIKHANOV, OTHERS J. NUCLEAR ENERGY 3, PART 2, 77-82 /AUGUST 1956/

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GAS COOLED REACTORS, FOREIGN

DF06

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NAME/OWNER	G-1 /GRAPHITE-REACTOR 1/CEA, FRANCE	
DESIGNER	CEA-FRANCE	
OPERATOR	CEA-EDF	
LOCATION	MARCOULE, FRANCE	
PURPOSE	PLUTONIUM PRODUCTION, CENTRAL STATION POWER PROTOTYPE	
TYPE	GCR, HORIZONTAL CONFIGURATION	
POWER MWE(MWT)	17	38
CRITICAL	1956	
COOLANT	AIR	
MODERATOR	GRAPHITE-HORIZONTAL CHANNELS	
FUEL MATERIAL	NATURAL URANIUM CAST BARS /SLUGS/	
FUEL GEOMETRY	RODS 26 MM. DIA./100 MM. LONG	
FUEL CLADDING	MAGNESIUM-ZIRCONIUM ALLOY	
FUEL ASSEMBLY	37 SLUGS IN ONE SHEATH 2 ELEMENTS PER CHANNEL 1337 HORIZONTAL CHANNELS	
FUEL CHARGE	100 TONS URANIUM	
NEUTRON FLUX	THERMAL AVE. 1.55×10^{12} FAST AVE. 2×10^{12}	
CONTROL	VERTICAL CONTROL RODS /BORON CARBIDE/ AND NEUTRON ABSORBER ELEMENTS.	
COOLANT TEMP.	INLET 20 C	OUTLET 200 C
REACTOR VESSEL	THERMAL AND BIOLOGICAL SHIELDS, NO PRESSURE VESSEL	
REMARKS	THE AIR-COOLED G-1 REACTOR HAS THREE AIR CIRCUITS FOR COOLING THE FUEL ELEMENTS, THERMAL SHIELD, AND FRONT AND REAR FACES. THE PRIMARY DIRECT CIRCUIT MAINTAINS THE URANIUM CLADDING AT A MAXIMUM 275 C.	
REFERENCES	THE G-1 REACTOR D MARTIN	

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ENERGIE NUCLEAIRE 5, 221-5 /JUNE 1963/

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GAS COOLED REACTORS. FOREIGN

DF07

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NAME/OWNER	G-2, G-3/CEA-ELECTRICITE DE FRANCE	
DESIGNER	CEA=FRANCE	
OPERATOR	CEA=EDF	
LOCATION	MARCOULE, FRANCE	
PURPOSE	PLUTONIUM PRODUCTION, POWER	
TYPE	GCR	
POWER MWE(MWT)	32	200 /UPRATED TO 240 /
CRITICAL	G-2 1959, G-3 1962	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE WITH HORIZONTAL CHANNELS	
FUEL MATERIAL	NATURAL U METAL, SOME CENTRAL RODS URANIUM-ALUMINUM ALLOY, 15-20 CHANNELS LOADED WITH THORIUM	
FUEL GEOMETRY	RODS 28.2 CM. LONG/2.8 AND 3.1 CM./PERIPHERAL/DIA.	
FUEL CLADDING	MAGNESIUM-ZIRCONIUM ALLOY 1.5 MM. THICK, FINNED	
FUEL ASSEMBLY	FINNED-CLAD RODS, 28 ELEMENTS/CHANNEL 1200 FUEL CHANNELS	
FUEL CHARGE	110 TONS URANIUM	
SPECIFIC POWER	1.82 KW/KG	
BURNUP(REFUEL)	400 MWD/TON	/ON-LOAD REFUELING/
NEUTRON FLUX	THERMAL MAX, 2.8×10^{13} FAST AVE, 1.2×10^{13}	
CONTROL	BORON CARBIDE RODS, STEEL CLADDING, NO BURNABLE POISON	
COOLANT TEMP.	333-307 C	
COOLANT PRESS.	15 KG/SQ. CM.	
REACTOR VESSEL	PRESTRESSED CONCRETE HORIZONTAL CYLINDER, DISKED ENDS, MASSIVE-BASE, 33.6 M. LONG /14 M. ID.	
CONTAINMENT	REACTOR BUILDING-CONVENTIONAL.	

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GAS COOLED REACTORS, FOREIGN

DF07

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REMARKS

BOTH G-2 AND G-3 HAVE BEEN UP-RATED TO 30-37 MWE
AND 240 MWT. G-3 IS EXPECTED TO PRODUCE 40 MW FOR
THE FRENCH NATIONAL GRID.

REFERENCES

DESCRIPTION OF REACTORS G-2 AND G-3.
SECOND U. N. INTL. CONF. ON THE PEACEFUL USES
OF ATOMIC ENERGY 8, 334-55 /1958/

THE WORLDS REACTORS, G-2 AND G-3.
NUCLEAR ENG, /INSERT/ /DECEMBER 1959/

THE G-2 AND G-3 INDUSTRIAL COMPLEXES.
L MAILLARD
ENERGIE NUCLEAIRE 5, 226-30 /JUNE 1963/

DIRECTORY OF NUCLEAR REACTORS. VOL. I, POWER
REACTORS, P. 151
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1959

JANUARY 1967

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GAS COOLED REACTORS, FOREIGN

DF08

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NAME/OWNER	EL-4 /EAU LOURDE/ CEA-FRANCE MONT D ARREE CENTRALE NUCLEAIRE	
DESIGNER	CEA-FRANCE	
OPERATOR	CEA-FRANCE	
LOCATION	MORLAIX, BRITTANY, FRANCE /NEAR BRENNILIS/	
PURPOSE	POWER, CONTRIBUTION TO EURATOM ORGEL PROJECT. /PROTOTYPE/	
TYPE	GCR, HEAVY WATER MODERATED, HORIZONTAL PRESSURE TUBE	
POWER MWE(MWT)	70	250
CRITICAL	CRITICAL DECEMBER 1966.	
COOLANT	CARBON DIOXIDE, FORCED CIRCULATION	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE SINTERED PELLETS	
FUEL GEOMETRY	ROD, 40 CM. LONG/11 MM. DIA.	
FUEL CLADDING	SS=THIN, LATER CORES BERYLLIUM, IRON-ALUMINUM OR ZIRCONIUM ALLOYS	
FUEL ENRICH.	FIRST CORE 1.4 PERCENT U-235, LATER NATURAL URANIUM	
FUEL ASSEMBLY	19-ROD CLUSTER, GRAPHITE SLEEVE, 9 ELEMENTS /CHANNEL	
SPECIFIC POWER	17 MWE/T	
BURNUP(REFUEL)	10,000 MWD/TON	/ON-LOAD REFUELING/
CONTROL	GAS RODS AND SOLUBLE POISON	
COOLANT TEMP.	INLET 260 C	OUTLET 475-500 C
COOLANT PRESS.	870 PSI	
REACTOR VESSEL	MOLYBDENUM-STAINLESS STEEL HORIZONTAL CYLINDER, 5.5 M. BETWEEN END PLATES, 4 M. ID., 30 MM. WALL THICKNESS, ZIRCALOY-2 FUEL TUBES JOINED TO END PLATES	

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DF08

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CONTAINMENT PRESTRESSED CONCRETE CYLINDER 46 M. ID, 44 M. HIGH
 WALL THICKNESS 2.36 IN.
 SPHERICAL DOME 60 CM. THICK

REMARKS PRESSURE TUBES ARE ZIRCALLOY, THERMALLY INSULATED
 FROM THE HOT GAS PASSING THROUGH THEM, COLD HEAVY
 WATER MODERATOR IS CONTAINED IN A VESSEL RIGIDLY
 CONNECTED TO THE POWER TUBES BY A LEAK-PROOF
 JUNCTION, THE HORIZONTAL CHANNELS ARE ACCESSIBLE
 FROM BOTH ENDS, THE FUEL ELEMENTS BEING MOVED
 ALONG THE LENGTH OF THE CHANNEL DURING IN-PILE
 LIFE. A SCALED-UP 500 MWE PLANT HAS BEEN STUDIED
 AS A REFERENCE DESIGN. AMONG THE COOLANTS
 STUDIED BRIEFLY WAS A SUSPENSION OF GRAPHITE IN
 CARBON DIOXIDE GAS. EL-5 AS PLANNED WILL BE A 300
 MWE PLANT WITH THE SAME BASIC CHARACTERISTICS
 AS EL-4.

REFERENCES EL-4. CHOICE OF PRINCIPAL PARAMETERS.
 B BAILLY DU BOIS, R. NAUDET
 SPM-620 /MARCH 1960/ IN FRENCH
 AEC-TR-4194 /TRANSLATION/

EL-4- AN ADVANCED NATURAL URANIUM REACTOR.
 NUCLEAR ENG. 8, 312-316 /SEPTEMBER 1963/

HEAVY WATER MODERATED GAS-COOLED REACTORS.
 B BAILLY DU BOIS, OTHERS
 THIRD U. N. INTL. CONF. ON THE PEACEFUL USES OF
 ATOMIC ENERGY, GENEVA, 1964 P. 39

EL-4 AND THE FRENCH HEAVY WATER/GAS LINE.
 R. CARLE, R. GIBRAT
 NUCLEAR ENG. 10, 171-174 /MAY 1965/

THE FRENCH NUCLEAR POWER STATION EL-4
 JC BRISSET
 INTL. CONF. CANADIAN NUCLEAR ASSOcn.
 PREPRINT 65-CNA-212
 CONF-650515-6

EL-4 FEATURES AND CONSTRUCTION PROBLEMS
 R CARLE, P SCHULHOFF
 3RD UN INTL. CONF. PEACEFUL USES ATOMIC ENERGY
 VOL. 5, 350-6 /1964/

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DF09

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NAME/OWNER BRENDA/SNECMA AND CEA, FRANCE
 PILE CHAUD

DESIGNER SOCIETE NATIONALE D-ETUDES ET DE CONSTRUCTION
 DE MOTEURS D-AVIATION /SNECMA/

LOCATION CADARACHE, FRANCE

PURPOSE AIRCRAFT PROPULSION PROTOTYPE

TYPE GCR

POWER MWE(MWT) 1

CRITICAL INITIAL CONSTRUCTION ONLY. DROPPED IN 1958

COOLANT GAS

MODERATOR BERYLLIUM OXIDE, GRAPHITE OR WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL CLADDING CERAMIC

REFERENCES NUCLEAR POWER 4,82 /APRIL 1959/
 NEWS RELEASE

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GAS COOLED REACTORS. FOREIGN

DF10

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NAME/OWNER EDF-1/ELECTRICITE DE FRANCE
 DESIGNER CEA, ELECTRICITE DE FRANCE
 OPERATOR ELECTRICITE DE FRANCE
 LOCATION CHINON, FRANCE
 PURPOSE POWER
 TYPE GCR, TWO-REGION CORE.
 POWER MWE(MWT) 68 300
 CRITICAL 1959
 COOLANT CARBON DIOXIDE
 MODERATOR GRAPHITE, VERTICAL CHANNELS
 FUEL MATERIAL URANIUM-MOLYBDENUM ALLOY
 FUEL GEOMETRY HOLLOW RODS 54CM. LONG/1.4 AND 3.5 CM, DIA.
 FUEL CLADDING MAGNESIUM-ALUMINUM ALLOY 1.8 MM, THICK, FINNED
 1.8 MM, THICK, RADIAL FINS
 FUEL ASSEMBLY 15 CARTRIDGES /CHANNEL
 1148 CHANNELS
 FUEL CHARGE 140,000 KG, URANIUM
 SPECIFIC POWER 2.1 KW/KG
 BURNUP(REFUEL) 3000 MWD/TON
 NEUTRON FLUX THERMAL AVE. 1.6×10^{13}
 FAST MAX. 3.3×10^{13}
 CONTROL SHIM-SAFETY RODS, REGULATING RODS, NO BURNABLE
 POISON
 COOLANT TEMP. INLET 140 C OUTLET 335 C
 COOLANT PRESS. 25 KG/SQ. CM.
 REACTOR VESSEL STEEL CYLINDER, HEMISPHERICAL ENDS.
 10CM. THICK/22.80 LONG, 10M. DIA.
 CONTAINMENT STEEL SPHERE 55 M. DIA.

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GAS COOLED REACTORS, FOREIGN

DF10

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REMARKS

FIRST REACTOR OF THE 3-REACTOR CHINON NUCLEAR
POWER STATION. REACTOR HAS A TWO-REGION CORE WITH
COMPACT CENTER, MORE WIDELY SPACED PERIPHERY,
COMMERCIAL OPERATION 1963.

REFERENCES

THE CHINON NUCLEAR POWER PLANT EDF-1 AND EDF-2
M ROUX
SECOND U. N. INTL. CONF. ON THE PEACEFUL USES
OF ATOMIC ENERGY 8,356-79 /1958/

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GAS COOLED REACTORS. FOREIGN

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NAME/OWNER EDF-2/ELECTRICITE DE FRANCE

DESIGNER CEA, ELECTRICITE DE FRANCE

OPERATOR ELECTRICITE DE FRANCE

LOCATION CHINON, FRANCE

PURPOSE POWER

TYPE GCR

POWER MWE(MWT) 195 785

CRITICAL AUGUST 1964

COOLANT CARBON DIOXIDE

MODERATOR GRAPHITE, VERTICAL CHANNELS, HEXAGONAL

FUEL MATERIAL URANIUM HOLLOW CYLINDERS

FUEL GEOMETRY HOLLOW RODS, 52.8 CM. LONG/2.4 AND 4.3 CM. DIA.

FUEL CLADDING MAGNESIUM-ZIRCONIUM ALLOY CANS, GRAPHITE SLEEVE,
/FINNED CANS/

FUEL ASSEMBLY FINNED HOLLOW ROD, 12 ELEMENTS/CHANNEL
2660 CHANNELS,HEX.SUBASSEMBLIES 36 CHANNELS
EACH

FUEL CHARGE 250,000 KG.URANIUM

SPECIFIC POWER 3.1 KG/KW

BURNUP(REFUEL) 3000 MWD/TON

NEUTRON FLUX THERMAL AVE. 1.7×10^{13}
FAST MAX. 3.5×10^{13}

CONTROL SHIM-SAFETY AND REGULATING RODS

COOLANT TEMP. INLET 195 C OUTLET 365 C

COOLANT PRESS. 25 KG/SQ. CM.

REACTOR VESSEL SPHERE OF WELDED STEEL PLATES 18.3 M.DIA./10.6CM.
THICK

CONTAINMENT NONE

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REMARKS

2ND STATION OF THE 3-REACTOR CHINON NUCLEAR
POWER STATION.

REFERENCES

THE CHINON NUCLEAR POWER PLANT EDF-1 AND EDF-2.
M ROUX
SECOND U. N. INTL. CONF. ON THE PEACEFUL USES
OF ATOMIC ENERGY 8, 356-79 /1958/

FIRST STEPS TOWARD CONVENTIONAL NUCLEAR POWER.
JP ROUX, C. BIENVENU
J. BRIT. NUCLEAR ENERGY SOC. 1/3/, 235-59
/JULY 1962/

NUCLEAR POWER STATION EDF-2, EDF-3, AND EDF-4
C BIENVENU, OTHERS
THIRD U. N. INTL. CONF. PEACEFUL USES OF ATOMIC
ENERGY, GENEVA, 1964. A/CONF.28/P/38

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GAS COOLED REACTORS. FOREIGN

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NAME/OWNER	EDF-3/ELECTRICITE DE FRANCE
DESIGNER	ELECTRICITE DE FRANCE
OPERATOR	ELECTRICITE DE FRANCE
LOCATION	CHINON, FRANCE
PURPOSE	POWER
TYPE	GCR
POWER MWE(MWT)	480
CRITICAL	MARCH 1966
COOLANT	CARBON DIOXIDE
MODERATOR	GRAPHITE
FUEL MATERIAL	URANIUM-MOLYBDENUM ALLOY TUBE
FUEL GEOMETRY	HOLLOW RODS
FUEL CLADDING	MAGNESIUM-ZIRCONIUM ALLOY, FINNED
FUEL ASSEMBLY	FINNED TUBE 2700 CHANNELS
FUEL CHARGE	400 TONS URANIUM
SPECIFIC POWER	1.1 MWE/TON
REACTOR VESSEL	PRESTRESSED CONCRETE
REMARKS	3RD STATION OF THE CHINON NUCLEAR POWER COMPLEX CONSTRUCTION WAS STARTED IN 1961.
REFERENCES	THE DEVELOPMENT IN FRANCE OF THE REACTOR SYSTEM NATURAL URANIUM-GRAPHITE-CARBON DIOXIDE EXPERIENCE ACQUIRED, FUTURE PROSPECTS, J HOROWITZ, JP ROUX BULL. INFORM. SCI. TECH. /PARIS/ NO.76.3-11 /OCT. 1963/ NUCLEAR POWER STATIONS EDF-2, EDF-3, AND EDF-4, C BIENVENU, OTHERS 3RD U. N. INTL. CONF. PEACEFUL USES OF ATOMIC ENERGY, GENEVA, 1964. A/CONF.28/P/38

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NAME/OWNER	EDF-4/ELECTRICITE DE FRANCE SAINT LAURENT DES EAUX	
DESIGNER	ELECTRICITE DE FRANCE	
OPERATOR	ELECTRICITE DE FRANCE	
LOCATION	LOIR-ET-CHER, NORMANDY, FRANCE	
PURPOSE	POWER	
TYPE	GCR INTEGRATED DESIGN. TWO-REACTOR STATION	
POWER MWE(MWT)	500 PER REACTOR	1650
CRITICAL	NO.1, 1968 NO.2, 1970	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE, GRAPHITE REFLECTOR	
FUEL MATERIAL	URANIUM ALLOY	
FUEL GEOMETRY	HOLLOW ROD 43 MM. OD./23 MM. ID.	
FUEL CLADDING	GRAPHITE SLEEVE, ZIRCALOY CAN.	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	43,110 FUEL ELEMENTS 2,874 FUEL CHANNELS	
FUEL CHARGE	445 TONS URANIUM	
CONTROL	RODS	
COOLANT TEMP.	INLET 217 C	OUTLET 400 C
COOLANT PRESS.	384 PSI	
REACTOR VESSEL	PRE-STRESSED CONCRETE VERTICAL CYLINDER, THE HEAT EXCHANGER IS ALSO LOCATED INSIDE THE PRESSURE VESSEL.	
REMARKS	CONSTRUCTION. TARGET FOR NO. 1 REACTOR 1968. PLANS HAVE INCLUDED STUDY OF THE INTEGRATED CONCEPT OR MONOBLOC DESIGN.	

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REFERENCES

NUCLEAR POWER STATIONS EDF-2, EDF-3, AND EDF-4,
C BIENVENU, OTHERS,
3RD U. N. INTL. CONF. PEACEFUL USES OF ATOMIC
ENERGY, GENEVA, 1964, A/CONF.28/P/38

NEW DESIGN OF REACTOR COMPLEX AND OF LOADING
MECHANISM,
ORNL-TN-82 /TRANSLATION OF PAPER FROM CANNES
SYMPOSIUM, 1962/

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NAME/OWNER	EDF=5/EDF-CEA, FRANCE BUGEY=1
DESIGNER	CEA, FRANCE
OPERATOR	ELECTRICITE DE FRANCE
LOCATION	BUGEY, NEAR LYONS, FRANCE
PURPOSE	POWER AND EXPERIMENTAL FACILITY
TYPE	GCR
POWER MWE(MWT)	500 2400
CRITICAL	CONSTRUCTION. TARGET 1970
COOLANT	CARBON DIOXIDE
MODERATOR	GRAPHITE
FUEL MATERIAL	URANIUM TUBES
FUEL GEOMETRY	ANNULAR ELEMENT INTERNAL AND EXTERNAL COOLING
FUEL CLADDING	MAGNESIUM ALLOY INNER AND OUTER CLADDING
FUEL ENRICH.	NATURAL
REACTOR VESSEL	PRESTRESSED CONCRETE
REMARKS	PLANNED WORK ON ANNULAR METAL ELEMENTS IS IN PROCESS /PROJECT INCA-INCORPORE ANNULAR/. THE CARBON DIOXIDE CIRCUIT WILL BE WITHIN THE CONCRETE VESSEL AND COMPLETELY INDEPENDENT OF STEAM AND WATER LOOPS. BUGEY-1 WILL BE THE FIRST OF FIVE UNITS
REFERENCES	PROPRIETE INDUSTRIELLE NUCLEAIRE NO. 9 /5-15-64/, VOL. 7, P. 14, NEWS RELEASE

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NAME/OWNER	CATALONIA NUCLEAR STATION/FRANCE-SPAIN
DESIGNER	SOCIA /INDATOM AND SEEN, FRANCE/
LOCATION	HOSPITALET OR VANDELLOS, CATALONIA, SPAIN, ON MEDITERRANEAN COAST
PURPOSE	POWER
TYPE	GCR
POWER MWE(MWT)	500 2400
CRITICAL	CONSTRUCTION APPROVED. TARGET 1970.
COOLANT	CARBON DIOXIDE
MODERATOR	GRAPHITE
FUEL MATERIAL	URANIUM METAL
FUEL GEOMETRY	ANNULAR ELEMENT
FUEL CLADDING	INNER AND OUTER CLADDING, BOTH FINNED MAGNESIUM ALLOY
FUEL ENRICH.	NATURAL
FUEL ASSEMBLY	SINGLE ELEMENT
REACTOR VESSEL	PRESTRESSED CONCRETE. HEAT EXCHANGER IS BELOW THE CORE WITHIN THE PRESSURE VESSEL
REMARKS	FORMAL APPROVAL HAS BEEN GIVEN FOR CONSTRUCTION BY BOTH FRENCH AND SPANISH GOVERNMENTS. THE REACTOR WILL BE AN IMPROVED VERSION OF EDF-4. WITH AN INTEGRATED DESIGN IN WHICH THE HEAT EXCHANGER IS POSITIONED BELOW THE CORE.
REFERENCES	APPLIED ATOMICS OCT. 7, 1964 P.12-13 NEWS RELEASE FRENCH REACTOR FOR SPAIN. NUCLEAR ENG. 9,393 /NOV.1964/

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NAME/OWNER EDF-RWE STATION
ELECTRICITE DE FRANCE AND W. GERMANY RWE

DESIGNER SIEMENS /W. GERMANY/ AND GAAA /FRANCE/

LOCATION RHINE RIVER, FRENCH SIDE

PURPOSE POWER

TYPE GCR, GRAPHITE MODERATED

POWER MWE(MWT) 500

CRITICAL PLANNED

COOLANT GAS

MODERATOR GRAPHITE

FUEL MATERIAL URANIUM DIOXIDE

FUEL ENRICH. NATURAL

REACTOR VESSEL PRESTRESSED CONCRETE

REMARKS AGREEMENT ON JOINT PROJECT HAS BEEN REACHED.
THERE IS ALSO A TENTATIVE PLAN FOR A HEAVY-WATER
MODERATED GCR TO BE BUILT LATER ON THE GERMAN SIDE
OF THE RIVER.

REFERENCES NUCLEONICS WEEK DEC.17,1964 P.1-2
NEWS RELEASE

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NAME/OWNER	BEERSHEBA STATION/ISRAEL
DESIGNER	ISRAEL, FRENCH ASSISTANCE
LOCATION	NEGEV DESERT NEAR BEERSHEBA, ISRAEL
PURPOSE	PILOT POWER, RESEARCH
TYPE	GCR, HEAVY WATER MODERATED
CRITICAL	TARGET 1964-5
COOLANT	CARBON DIOXIDE
MODERATOR	HEAVY WATER
FUEL MATERIAL	URANIUM
FUEL ENRICH.	NATURAL
REMARKS	REPORTEDLY UNDER CONSTRUCTION. NO RECENT INFORMATION.
REFERENCES	NUCLEONICS 19,26/FEB. 1961/ NEWS RELEASE

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NAME/OWNER	LATINA/SIMEA, ITALY	
DESIGNER	NPPC /UK/ AND AGIP NUCLEARE /ITALY/	
OPERATOR	SIMEA, ITALY	
LOCATION	LATINA, ITALY	
PURPOSE	POWER	
TYPE	GCR	
POWER MWE(MWT)	200	705
CRITICAL	DEC. 1963	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE, VERTICAL CHANNELS	
FUEL MATERIAL	URANIUM	
FUEL GEOMETRY	URANIUM METAL RODS, 29.3 MM. DIA./914.4 MM. LONG	
FUEL CLADDING	MAGNOX CANS, 2 MM. THICK, GRAPHITE SLEEVE	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	SPIRAL FINNED ELEMENT, 8 ELEMENTS/CHANNEL 2929 FUEL CHANNELS	
FUEL CHARGE	268 TONS URANIUM	
SPECIFIC POWER	2.62 KW/KG URANIUM	
CONTROL	BORON STEEL RODS	
COOLANT TEMP.	INLET 180 C	OUTLET 390 C
REACTOR VESSEL	PRESSURE VESSEL 20.35 M. DIA.	
CONTAINMENT	CONCRETE BUILDING	
REMARKS	ELECTRICITY PRODUCTION IN MAY 1963. FUEL IS COMPOSED OF NATURAL URANIUM METAL RODS IN MAGNOX CANS. THE ELEMENT WILL BE THE POLYZONAL SPIRAL TYPE, WITH SPIRAL FINS AND AXIAL FLOW SEPARATORS OR SPLITTERS.	
REFERENCES	FOR BASIC DESIGN SEE CALDER	

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LATINA,
NUCLEAR ENG. 4, 329-40 /OCTOBER 1959/

LATINA NUCLEAR POWER STATION, COMMISSIONING AND
INITIAL OPERATING EXPERIENCE
A BERTINI, OTHERS
3RD UN INTL. CONF. PEACEFUL USES ATOMIC ENERGY
VOL. 5, 38-46 /1964/

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NAME/OWNER	TOKAI ATOMIC STATION/JAPCO, JAPAN	
DESIGNER	GEC-SC, UNITED KINGDOM	
OPERATOR	JAPAN ATOMIC POWER CO.	
LOCATION	TOKAI-MURA, JAPAN	
PURPOSE	POWER	
TYPE	GCR	
POWER MWE(MWT)	150	570
CRITICAL	1965. POWER PRODUCED NOV. 1965 COMMERCIAL OPERATION AT 120 MWE EARLY 1966	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE, VERTICAL CHANNELS	
FUEL MATERIAL	URANIUM	
FUEL GEOMETRY	RODS, HOLLOW, 40.8 MM. OD./23.7 MM.ID./714 MM.LONG	
FUEL CLADDING	MAGNOX CAN=OUTSIDE CANNING ONLY. GRAPHITE SLEEVE	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	FINNED MAGNOX CANNED ELEMENTS, 8/CHANNEL 2048 CHANNELS	
FUEL CHARGE	187 TON URANIUM	
SPECIFIC POWER	3.14 KW/KG URANIUM	
NEUTRON FLUX	THERMAL AVE. 2×10^{13}	
CONTROL	RODS, TOP-MOUNTED	
COOLANT TEMP.	INLET 203 C	OUTLET 390 C
COOLANT PRESS.	205 PSIG	
REACTOR VESSEL	SPHERICAL PRESSURE VESSEL, 62 FT.ID./3 1/4 IN. THICK	

REMARKS A HOLLOW FUEL ELEMENT, CANNED ON THE OUTSIDE ONLY, HAS BEEN ADOPTED FOR THE TOKAI PLANT. THE CAN IS SEALED AT EACH END BY END PLUGS. IS LONGITUDINALLY

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FINNED WITH HELICAL SWIRLERS, AND IS SUPPORTED
INSIDE A GRAPHITE SLEEVE,

REFERENCES

FOR BASIC DESIGN SEE CALDER

JAPANS FIRST NUCLEAR POWER STATION,
PA LINDLEY, OTHERS
NUCLEAR POWER 5, 104-13 /MARCH 1960/

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NAME/OWNER	GCR STUDY/FAPIG. JAERI. JAPAN
DESIGNER	FIRST ATOMIC POWER INDUSTRY GROUP JAPAN ATOMIC ENERGY RESEARCH INST.
PURPOSE	POWER
TYPE	GCR, HIGH TEMPERATURE, DIRECT CYCLE
POWER MWE(MWT)	9.9 31
CRITICAL	DESIGN
COOLANT	HELIUM
MODERATOR	GRAPHITE
FUEL MATERIAL	URANIUM CARBIDE COATED WITH CARBON, DISPERSED IN GRAPHITE, THORIUM CARBIDE MAY BE USED,
FUEL GEOMETRY	ROD, 6.0 CM. OD./150 CM. LONG
FUEL CLADDING	GRAPHITE SHEATH
FUEL ASSEMBLY	RODS, DOUBLE GRAPHITE SHEATH 400 ELEMENTS
BURNUP(REFUEL)	APPROX. 30 MONTHS
NEUTRON FLUX	THERMAL AVE. 5.15 10+13
COOLANT TEMP.	INLET 488 C OUTLET 754 C
COOLANT PRESS.	30 KG/SQ. CM.
REACTOR VESSEL	PRESSURE VESSEL
REMARKS	DEVELOPMENTAL STUDIES.
REFERENCES	ON NUCLEAR DESIGN OF THE SEMI-HOMOGENEOUS, HIGH-TEMPERATURE, GAS-COOLED REACTOR. SIGERU YASUKAWA ET AL. JAERI-1049 /MARCH 1963//IN JAPANESE/ CONCEPTUAL DESIGN OF A POWER STATION USING A /EXPERIMENTAL/ SEMIHOMOGENEOUS HIGH-TEMPERATURE GAS COOLED REACTOR. FIRST ATOMIC POWER IND. GROUP, TOKYO, FAPIG /TOKYO/ 27/2/, 91-120 /AUG. 1963/

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/IN JAPANESE/

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NAME/OWNER	EDEYRN STATION/CEGB, UNITED KINGDOM
DESIGNER	NOT SELECTED
OPERATOR	CENTRAL ELECTRIC GENERATING BOARD, U.K.
LOCATION	CAERNARVONSHIRE, WALES
PURPOSE	POWER
TYPE	GCR
CRITICAL	PLANNED
COOLANT	CARBON DIOXIDE
MODERATOR	GRAPHITE
REMARKS	PLANNED
REFERENCES	FOR BASIC DESIGN SEE CALDER

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NAME/OWNER	CALDER HALL/ATOMIC ENERGY AUTHORITY UNITED KINGDOM	
DESIGNER	UK AEA	
OPERATOR	UK AEA	
LOCATION	CALDER HALL, CUMBERLAND, ENGLAND	
TYPE	GCR /4-REACTOR STATION/	
POWER MWE(MWT)	45	235
CRITICAL	1956-1958 /A1,1956,A2,1956,B3,1958,B4,1958/	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE, VERTICAL CHANNELS	
FUEL MATERIAL	URANIUM	
FUEL GEOMETRY	SOLID RODS, CYLINDRICAL 2.92 CM. DIA/101.5CM, LONG	
FUEL CLADDING	MAGNESIUM ALLOY /MAGNOX/ CAN, 0.8 MM. THICK	
FUEL ASSEMBLY	SOLID RODS IN MAGNESIUM ALLOY CAN, 6 ELEMENTS/CHANNEL. HELICAL FINS /RODS LOADED ONE ON TOP OF THE OTHER/ 1696 VERTICAL FUEL CHANNELS	
FUEL CHARGE	127 TON URANIUM	
SPECIFIC POWER	1.38 KW/KG U	
NEUTRON FLUX	THERMAL AVE, 6.02 E+12 FAST AVE 2.14 E+13	
CONTROL	RODS, BORDON STEEL IN SS, TOP-MOUNTED	
COOLANT TEMP.	INLET 140 C	OUTLET 336 C
COOLANT PRESS.	INLET 7.03 KG/SQ.CM,OUTLET 6.7 KG/SQ. CM.	
REACTOR VESSEL	STEEL CYLINDER, ELLIPSOID ENDS 11.25 M.ID. /21.65 M. HIGH, 5.08 CM. THICK	
CONTAINMENT	BIOLOGICAL SHIELD AND REACTOR BUILDING	
REMARKS	THE HEAT OUTPUT OF EACH REACTOR HAS BEEN INCREASED TO 220 MW.	
REFERENCES	SYMPOSIUM ON CALDER WORKS NUCLEAR POWER PLANT.	

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J. BRIT. NUCLEAR ENERGY CONF. 2, 41-291 /1957/

COMMISSIONING AND OPERATION OF A STATION, CALDER
WORKS, H. G. DAVEY

J. BRIT. NUCLEAR ENERGY CONF. 3, 101-8/APRIL 1958/

DESIGN OF GAS-COOLED, GRAPHITE MODERATED REACTORS
DR POULTER, ED,
OXFORD UNIV. PRESS, N. Y. 1963

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GAS COOLED REACTORS. FOREIGN

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NAME/OWNER CHAPEL CROSS/ATOMIC ENERGY AUTHORITY, U.K.

DESIGNER UK AEA

OPERATOR UK AEA

LOCATION CHAPEL CROSS, DUMFRIESCHIRE, SCOTLAND

PURPOSE PLUTONIUM PRODUCTION, POWER

TYPE GCR-CALDER HALL DESIGN

POWER MWE(MWT) 35 235-240
4-REACTOR STATION

CRITICAL 1959-1960 /4TH REACTOR MARCH 1960/

COOLANT CARBON DIOXIDE

MODERATOR GRAPHITE, VERTICAL CHANNELS

FUEL MATERIAL URANIUM

FUEL GEOMETRY RODS 2.92 CM. DIA./101.5 CM. LONG

FUEL CLADDING MAGNOX 0.8 MM. THICK REMOVABLE GRAPHITE SLEEVES
IN REACTORS 2,3, AND 4

FUEL ENRICH. NATURAL

FUEL ASSEMBLY SOLID CYLINDRICAL RODS, MAGNOX CAN, FINNED
6 ELEMENTS/CHANNEL
1696 FUEL CHANNELS

FUEL CHARGE 127 TON URANIUM

SPECIFIC POWER 1.38 KW/KG U

CONTROL RODS BORON STEEL IN SS, TOP-MOUNTED

COOLANT TEMP. OUTLET 340 C

REMARKS HEAT OUTPUT OF EACH REACTOR WAS INCREASED TO 220
MW IN MARCH, 1961REFERENCES CHAPEL CROSS.
NUCLEAR ENG. 4, 250-2 /JUNE 1959/

JANUARY 1967

BNWL-326

GAS COOLED REACTORS, FOREIGN

DF24

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NAME/OWNER WINDSCALE AGR/ATOMIC ENERGY AUTHORITY, U.K.
 DESIGNER UK AEA
 OPERATOR UK AEA
 LOCATION WINDSCALE, CUMBERLAND, ENGLAND
 PURPOSE POWER PROTOTYPE
 TYPE GCR, HIGH TEMPERATURE
 POWER MWE(MWT) 33 105
 CRITICAL AUGUST 1962
 COOLANT CARBON DIOXIDE /HELIUM STUDIED AS ALTERNATE/
 MODERATOR GRAPHITE
 FUEL MATERIAL URANIUM DIOXIDE PELLETS, SINTERED, 0.400 IN. DIA./
 0.40 IN. LONG
 FUEL GEOMETRY PENCILS
 FUEL CLADDING SS CANS 0.015 IN. THICK RIBBED
 FUEL ENRICH. 2.5 PER CENT U-235
 FUEL ASSEMBLY MARK 2 FUEL, 21-ELEMENT /PENCIL/ CLUSTER IN
 GRAPHITE SLEEVE /3FT. LONG/, FUEL ELEMENT ASSEMBLY
 IS COMPOSED OF 2 CLUSTERS, FUEL ELEMENT STRINGER
 /ACTIVE LENGTH 14 FT. 5 IN./ IS MADE UP OF
 4 ASSEMBLES.
 253 FUEL CHANNELS /197 IN USE/
 FUEL CHARGE 290 KG. U-235
 SPECIFIC POWER 350 KW/KG U-235
 BURNUP(REFUEL) 10,000 MWD/TON U /CONTINUOUS=DURING OPERATION/
 NEUTRON FLUX THERMAL AVE. 1.49×10^{13}
 CONTROL BORON STEEL RODS
 COOLANT TEMP. INLET 250-325 C OUTLET 500-575 C
 COOLANT PRESS. 270 PSIG
 REACTOR VESSEL CYLINDER 21 FT. ID./54 FT. HIGH, DOUBLE-SHELL

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CONSTRUCTION

CONTAINMENT STEEL HEMISPHERICAL TOP, TRUNCATED-CONE LOWER HALF

REMARKS ZERO-ENERGY EXPERIMENT /HERO/ CRITICAL IN FEBRUARY 1962. BERYLLIUM CLADDING, PLANNED FOR FIRST CORE, WILL NOT BE USED. IN THE BERYLLIUM DESIGN, THERE WERE 36 FUEL ELEMENT RODS PER CLUSTER, AND THREE SUCH CLUSTERS PER BERYLLIUM ELEMENT SUBASSEMBLY. COOLANT FLOW IS UPWARD INTO A COLLECTOR BOX ABOVE THE CORE. PRESSURE VESSEL IS OF DOUBLE-SHELL CONSTRUCTION, THE INNER SHELL CONTAINING THE HOT GAS AND THE OUTER SHELL OPERATING AT THE COOLER INLET GAS TEMPERATURE. FULL POWER OPERATION IN FEBRUARY 1963, WITH ELECTRICITY SUPPLIED TO THE NATIONAL GRID. PRELIMINARY PROPOSALS FOR ONE OR TWO 500 MWE AGR PLANTS HAVE BEEN INVITED BY CEGB. POSSIBLE SITE IS DUNGENESS.

REFERENCES

DESIGN CONCEPT OF THE AGR,
RV MOORE
ELEC. REVIEW 169, 774-92/NOVEMBER 17, 1961/

THE DESIGN OF GAS-COOLED, GRAPHITE-MODERATED
REACTORS,
DR POULTER, ED,
OXFORD UNIV. PRESS, N. Y, 1963.

AGR
NUCLEAR ENG. 6,151-58 /APRIL 1961/

SYMPOSIUM ON THE ADVANCED GAS-COOLED REACTOR,
BRITISH NUCLEAR ENERGY SOC. J. 2/2/ 95-294
/APRIL 1963/

JANUARY 1967

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GAS COOLED REACTORS, FOREIGN

DF25

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NAME/OWNER	DUNGENESS-B/CEGB, UNITED KINGDOM AGR-2	
DESIGNER	ATOMIC POWER CONSTRUCTION LTD., UK. AGR-2 DESIGN BY UK AEA	
OPERATOR	CENTRAL ELECTRIC GENERATING BOARD	
LOCATION	KENT, ENGLAND	
PURPOSE	POWER	
TYPE	GCR, ADVANCED HIGH TEMPERATURE TWO-REACTOR STATION	
POWER MWE(MWT)	600 PER REACTOR	
CRITICAL	CONTRACT AWARD 1965, TARGET 1970	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS, SINTERED, 0.57 IN. DIA.	
FUEL GEOMETRY	PINS 0.57 IN. DIA./40 IN. LONG	
FUEL CLADDING	SS CANS 0.015 IN. WALL THICKNESS	
FUEL ENRICH.	1.47-1.76 PER CENT U-235	
FUEL ASSEMBLY	CLUSTERS, 18 PENCILS/CLUSTER, GRAPHITE SLEEVE. 3-RING CLUSTER 8-ELEMENT STRINGERS, 465 CHANNELS /412 AT EQUILIBRIUM/ ACTIVE CORE HEIGHT 27 FT.	
BURNUP(REFUEL)	18000-20000 MWD/T	CONTINUOUS ON-LOAD AXIAL SHUFFLING
CONTROL	RODS	
COOLANT TEMP.	INLET 320 C	OUTLET 675 C
COOLANT PRESS.	450 PSI	
REACTOR VESSEL	PRESTRESSED CONCRETE CYLINDER, INNER SEAL OF WATER COOLED MILD STEEL MEMBRANE, VESSEL HOUSES CORE, GAS CIRCULATORS, AND BOILERS. INNER PRESSURE SHELL	

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GAS COOLED REACTORS, FOREIGN

DF25

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SEPARATES CORE FROM BOILER,

CONTAINMENT

SINGLE CONCRETE BUILDING HOUSES BOTH REACTORS AND
OTHER PLANT EQUIPMENT. REACTOR CENTERS ARE 160 FT.
APART.

REMARKS

APC-S ADVANCED GCR DESIGN WAS SELECTED FOR THE
SECOND COMPLEX AT DUNGENESS STATION.

REFERENCES

ADVANCED GAS-COOLED REACTORS-AN ASSESSMENT,
RV MOORE, JT THORN,
BRITISH NUCLEAR ENERGY SOC, J. 2/2/, 97-111
/APRIL 1963/DUNGENESS-B AGR REACTOR POWER STATION
ATOM NO. 7, P. 168-74 /SEPT. 1965/MAIN DESIGN FEATURES OF DUNGENESS-B
NUCLEAR ENG, 10, 347 /SEPT. 1965/DUNGENESS-B AGR NUCLEAR POWER STATION
CEGB, LONDON
NP-15473 /ND/

JANUARY 1967

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GAS COOLED REACTORS. FOREIGN

DF26

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NAME/OWNER	BERKELEY/CENTRAL ELECTRIC GENERATING BOARD, U.K.	
DESIGNER	AEI-JOHN THOMPSON, U.K.	
OPERATOR	CENTRAL ELECTRIC GENERATING BOARD	
LOCATION	BERKELEY, GLOUCESTERSHIRE, ENGLAND	
PURPOSE	POWER	
TYPE	GCR, CALDER-TYPE	
POWER MWE(MWT)	138	560
	TWO-REACTOR STATION	
CRITICAL	APRIL-MAY 1962	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE, VERTICAL CHANNELS, GRAPHITE REFLECTOR	
FUEL MATERIAL	URANIUM	
FUEL GEOMETRY	ROD 1.1 IN. DIA./19 IN. LONG	
FUEL CLADDING	MAGNOX, HELICAL FINS	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	U SLUGS IN MAGNOX TUBES, 24 IN. LONG 13 ELEMENTS/CHANNEL /STACKED/ 3265 FUEL CHANNELS	
FUEL CHARGE	231 TONS U	
SPECIFIC POWER	2.4 KW/KG URANIUM	
BURNUP(REFUEL)	3000 MWD/T AVE.	ON-LOAD, PARTIAL 10 CHANNELS/WEEK
NEUTRON FLUX	THERMAL AVE. 9.6×10^{12} CORE CENTER 1.7×10^{13}	
CONTROL	RODS, BORON IN STEEL, TOP-MOUNTED	
COOLANT TEMP.		OUTLET 345 C
COOLANT PRESS.	139 PSIA /INLET/	
REACTOR VESSEL	CYLINDER, 50 FT. DIA., 3-IN. THICK STEEL,	

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GAS COOLED REACTORS. FOREIGN

DF26

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80 FT HIGH AND 50 FT HIGH /2-REACTORS/

CONTAINMENT REACTOR BUILDING

REMARKS BOTH REACTORS IN OPERATION IN APRIL-MAY 1962.
 BERKELEY BEGAN PRODUCING 6000 KWE ON THE NO. 1
 GENERATOR IN JUNE 1962.

REFERENCES SEE CALDER

REACTORS ON-THE-LINE. NO. 10. BERKELEY.
 NUCLEONICS 12, /FACING PAGE 36/ /DECEMBER 1961/

BERKELEY CONSTRUCTION, SECTION DRAWINGS
 NUCLEAR ENG, 8,157-163 /MAY 1963/

JANUARY 1967

BNWL=326

GAS COOLED REACTORS, FOREIGN

DF27

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NAME/OWNER DRAGON/ATOMIC ENERGY AUTHORITY, U.K. AND
 EUROPEAN NUCLEAR ENERGY AGENCY /ENEA/
 DESIGNER ATOMIC ENERGY RESEARCH ESTABLISHMENT, U.K.
 OPERATOR UK AERE
 LOCATION WINFRITH HEATH, ENGLAND
 PURPOSE POWER EXPERIMENT
 TYPE GCR, HIGH TEMPERATURE, CERAMIC SYSTEM
 POWER MWE(MWT) 0 20
 CRITICAL AUG. 1964. POWER OUTPUT 20 MWT APRIL 1966
 COOLANT HELIUM
 MODERATOR GRAPHITE
 FUEL MATERIAL URANIUM-THORIUM CARBIDES, SINTERED COMPACTS WITH
 GRAPHITE COATING
 FUEL GEOMETRY ANNULAR ROD, 6 FT. LONG
 FUEL CLADDING GRAPHITE TUBES
 FUEL ASSEMBLY FUEL-MODERATOR ELEMENTS, CLUSTERS OF HEXAGONAL
 GRAPHITE TUBES CONTAINING GRAPHITE FUEL BOXES
 WITH ANNULAR FUEL INSERTS.
 37 ASSEMBLIES/CORE, /CENTRAL AND PERIPHERAL
 ZONES/
 SPECIFIC POWER 1.4 MW/KG
 BURNUP(REFUEL) 100,000 MWD/TON CAPABILITY
 CONTROL RODS, BORON CARBIDE IN SS TUBES
 COOLANT TEMP. INLET 350 C OUTLET 750 C
 COOLANT PRESS. 300 PSIA
 REACTOR VESSEL CYLINDER, CONICAL TOP 350 CM. DIA.
 CONTAINMENT INNER STEEL SHELL, OUTER CONTAINMENT BUILDING OF
 SEALED CONCRETE.
 REMARKS DRAGON IS A JOINT UNDERTAKING BY UK AND ENEA

REFERENCES

APPLIED ATOMICS AUG. 17, 1966 P. 2-3
NEWS RELEASE

JANUARY 1967

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GAS COOLED REACTORS, FOREIGN

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NAME/OWNER	TRANSFYNYDD/CENTRAL ELECTRIC GENERATING BOARD, U.K	
DESIGNER	ATOMIC POWER CO., U.K.	
OPERATOR	CEGB	
LOCATION	MERIONETHSHIRE, WALES	
PURPOSE	POWER	
TYPE	GCR, CALDER TYPE	
POWER MWE(MWT)	250	870 /TWO-REACTOR STATION/
CRITICAL	NO. 1 SEPT, 1964, ON-LINE JAN. 1965 NO. 2 DEC, 1964	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE, VERTICAL CHANNELS	
FUEL MATERIAL	URANIUM	
FUEL GEOMETRY	ROD 1 1/8 IN. DIA.	
FUEL CLADDING	MAGNOX, LONGITUDINAL SPIRAL	
FUEL ASSEMBLY	9 ELEMENTS/CHANNEL /STACKED/ 3720 FUEL CHANNELS	
FUEL CHARGE	280 TONS URANIUM	
SPECIFIC POWER	3.11 KW/KG URANIUM	
BURNUP(REFUEL)	4500 MWD/TON U	ON-LOAD
CONTROL	BORON STEEL RODS	
COOLANT TEMP.		OUTLET 392 C
COOLANT PRESS.	240 PSIG	
REACTOR VESSEL	STEEL SPHERE 61 FT. ID., 3 1/2 IN. PLATE THICKNESS	
REMARKS	ON-LINE IN JANUARY 1965.	
REFERENCES	FOR BASIC DESIGN SEE CALDER TRANSFYNYDD NUCLEAR ENG. 6,12-23 /JAN. 1961/	

JANUARY 1967

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GAS COOLED REACTORS. FOREIGN

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THE APC-S DESIGN FOR TRAWSFYNYDD
NUCLEAR ENG, 4, 289-90 /JULY, AUGUST, SEPTEMBER,
1959/

TRAWSFYNYDD DESIGN FEATURES.
NUCLEAR ENERGY ENG, 13, 489-95 /OCTOBER 1959/

JANUARY 1967

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GAS COOLED REACTORS. FOREIGN

DF29

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NAME/OWNER HINKLEY POINT=1/CENTRAL ELECTRIC GEN. BOARD, U.K.

DESIGNER ATOMIC POWER GROUP, U.K.

OPERATOR CEGB

LOCATION HINKLEY POINT, SOMERSET, ENGLAND

PURPOSE POWER:

TYPE GCR, CALDER TYPE

POWER MWE(MWT) 250 971

CRITICAL NO. 1, 1964, POWER TO GRID FEB, 1965
NO. 2, OCT, 1964, POWER 1966

COOLANT CARBON DIOXIDE

MODERATOR GRAPHITE, VERTICAL CHANNELS

FUEL MATERIAL URANIUM

FUEL GEOMETRY ROD 1 1/8 IN. DIA, /36 IN. LONG

FUEL CLADDING MAGNOX, FINNED

FUEL ENRICH. NATURAL

FUEL ASSEMBLY 8 ELEMENTS/CHANNEL /STACKED/
4500/ FUEL CHANNELS

FUEL CHARGE 376 TONS URANIUM

BURNUP(REFUEL) MINIMUM 3000 MWD/TON

NEUTRON FLUX THERMAL MAX, 3×10^{13}
FAST MAX, 3.6×10^{13}

CONTROL RODS, BORON STEEL

COOLANT TEMP. INLET 180 C OUTLET 375 C

COOLANT PRESS. 200 PSIA

REACTOR VESSEL BOILER PLATE STEEL SPHERE, 67 FT. DIA.

CONTAINMENT REACTOR BUILDING

REMARKS CEGB WILL BUILD A SECOND STATION AT SITE.

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GAS COOLED REACTORS, FOREIGN

DF29

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A PROPOSAL BY TNGP IS FOR AN ADVANCED GAS-COOLED
REACTOR,
SEE DF40

REFERENCES FOR BASIC DESIGN SEE CALDER

HINKLEY POINT
NUCLEAR ENG. 3, 286 /JULY 1958/

HINKLEY POINT NUCLEAR POWER STATION
D REED
NUCLEAR ENERGY SEPT. 1965 P. 272-83

JANUARY 1967

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GAS COOLED REACTORS. FOREIGN

DF30

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NAME/OWNER	SIZEWELL/CENTRAL ELECTRIC GENERATING BOARD, U.K.	
DESIGNER	ATOMIC POWER GROUP, U.K.	
OPERATOR	CEGB	
LOCATION	ALDEBURGH, SUFFOLK COAST, ENGLAND	
PURPOSE	POWER	
TYPE	TWIN MAGNOX GCR	
POWER MWE(MWT)	290	948
	PER REACTOR	
CRITICAL	NO. 1 REACTOR DEC. 1965 NO. 2 REACTOR EARLY 1966	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE	
FUEL MATERIAL	URANIUM	
FUEL GEOMETRY	ROD, 42 IN. ACTIVE LENGTH	
FUEL CLADDING	MAGNOX, POLYZONAL HELICALLY FINNED	
FUEL ASSEMBLY	7 RODS/CHANNEL /STACKED/ 3800 FUEL CHANNELS	
FUEL CHARGE	321 TONS URANIUM	
SPECIFIC POWER	2.96 KW/KG URANIUM	
BURNUP(REFUEL)	ON-LOAD	
CONTROL	RODS, STEEL WITH BORON STEEL INSERTS	
COOLANT TEMP.	INLET 214 C	OUTLET 410 C
COOLANT PRESS.	279 PSIA	
REACTOR VESSEL	STEEL SPHERES 63 FT. 6 IN. ID., 4.125 IN. THICK	
CONTAINMENT	SINGLE REACTOR BUILDING TO HOUSE BOTH REACTORS.	
REMARKS	CONSTRUCTION	
REFERENCES	FOR BASIC DESIGN SEE CALDER	

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GAS COOLED REACTORS, FOREIGN

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SIZEWELL NUCLEAR POWER STATION,
BRITISH POWER ENG. 2/2/, 86-6 /JANUARY 1961/

SIZEWELL NUCLEAR POWER STATION,
HS ARMS, OTHERS
NUCLEAR POWER 6, 61-81 /SEPTEMBER 1961/

FROM HINKLEY TO SIZEWELL,
NUCLEAR ENG. 6, 364-70 /SEPT. 1961/

BRITAIN-S SEVENTH NUCLEAR POWER STATION
ENGINEERING 200, 70 /JULY 16, 1965/

JANUARY 1967

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GAS COOLED REACTORS. FOREIGN

DF31

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NAME/OWNER	HUNTERSTON STATION/S. OF SCOTLAND ELECTRICITY BOARD	
DESIGNER	GENERAL ELECTRIC CO. LTD., SIMON CARVES, U.K.	
OPERATOR	S. SCOTLAND ELECTRICITY BOARD	
LOCATION	AYRSHIRE /WEST KILBRIDE/ SCOTLAND	
PURPOSE	POWER	
TYPE	GCR, TWO-REACTOR STATION	
POWER MWE(MWT)	150	530
	PER REACTOR	
CRITICAL	NO. 1 SEPT. 1963 NO. 2 APRIL 1964	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE	
FUEL MATERIAL	URANIUM	
FUEL GEOMETRY	RODS 1.15 IN. DIA./24 IN. LONG	
FUEL CLADDING	MAGNOX, POLYZONAL AXIAL FINNED GRAPHITE SLEEVE	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	10 RODS/CHANNEL /STACKED/ 3288 FUEL CHANNELS	
FUEL CHARGE	251 TONS URANIUM	
SPECIFIC POWER	2.13 KW/KG URANIUM	
BURNUP(REFUEL)	APPROX. 2100 MWD/TON /ON-POWER, BOTTOM LOAD/	
NEUTRON FLUX	THERMAL MAX. 1.35×10^{13}	
CONTROL	RODS, BORON STEEL	
COOLANT TEMP.	INLET 400 F	OUTLET 735 F
COOLANT PRESS.	150 PSI	
REACTOR VESSEL	STEEL SPHERE 70 FT. ID. AND 3 IN. THICK WALL	
CONTAINMENT	REACTOR BUILDING	

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GAS COOLED REACTORS, FOREIGN

DF31

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REMARKS STATION ON-LINE IN JUNE 1964

REFERENCES FOR BASIC DESIGN SEE CALDER

GAS COOLED REACTOR FOR THE SOUTH OF SCOTLAND
ELECTRICITY BOARD.

PJ GRANT

NUCLEONICS 16, 108-13 /MAY 1958/

HUNTERSTON, MOST POWERFUL ATOMIC STATION.
ENGINEERING 198, 386-7 /SEPT, 25, 1964/

JANUARY 1967

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GAS COOLED REACTORS. FOREIGN

DF32

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NAME/OWNER	DUNGENESS-A/CEGB, UNITED KINGDOM	
DESIGNER	THE NUCLEAR POWER GROUP, U.K.	
OPERATOR	CEGB	
LOCATION	KENT, ENGLAND	
PURPOSE	POWER	
TYPE	GCR, CALDER TYPE	
POWER MWE(MWT)	275	840 /TWO-REACTOR STATION/
CRITICAL	NO. 1 REACTOR JUNE 1965 NO. 2 REACTOR OCT, 1965	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE	
FUEL MATERIAL	URANIUM	
FUEL GEOMETRY	ROD, 1.10 IN. DIA./38.3 IN. LONG	
FUEL CLADDING	MAGNOX	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	7 ELEMENTS/CHANNEL /STACKED/ 3932 CHANNELS	
FUEL CHARGE	300 TONS URANIUM	
SPECIFIC POWER	2.78 KW/KG URANIUM	
CONTROL	RODS	
COOLANT TEMP.	INLET 250 C	OUTLET 410 C
REACTOR VESSEL	MILD STEEL SPHERICAL VESSEL.	
CONTAINMENT	BUILDING WITH VAULT FOR REACTOR PRESSURE VESSEL	
	DUNGENESS NUCLEAR POWER STATION RD VAUGHAN, OTHERS NUCLEAR POWER 6, 76-96 /APRIL 1961/	

JANUARY 1967

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GAS COOLED REACTORS, FOREIGN

DF33

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NAME/OWNER OLDBURY/CENTRAL ELECTRIC GENERATING BOARD, U.K.

DESIGNER THE NUCLEAR POWER GROUP, U.K.

OPERATOR CEGB

LOCATION OLDBURY-ON-SEVERN, GLOUCESTERSHIRE, ENGLAND

PURPOSE POWER

TYPE GCR, CALDER TYPE
 2-REACTOR STATION

POWER MWE(MWT) 280 834

CRITICAL NO.1 1966
 NO.2 1967

COOLANT CARBON DIOXIDE

MODERATOR GRAPHITE

FUEL MATERIAL URANIUM

FUEL GEOMETRY RODS, 1.10 IN. OD. /38.3 IN. LONG

FUEL CLADDING MAGNOX, SPIRAL FINS

FUEL ASSEMBLY 8 ELEMENTS/CHANNEL /STACKED/
 3308 CHANNELS
 3320 FUEL CHANNELS

FUEL CHARGE 293 TONS URANIUM

SPECIFIC POWER 2.85 KW/KG URANIUM

BURNUP(REFUEL) 4500 MWD/TON U

CONTROL RODS, TOP-SUSPENDED

COOLANT TEMP. INLET 245 C OUTLET 410 C

COOLANT PRESS. 364.3 PSIA

REACTOR VESSEL PRESTRESSED CONCRETE VERTICAL CYLINDER
 77 FT. ID., 60 FT. INNER HEIGHT, END SLABS 22 FT.
 THICK, WALL THICKNESS 15 FT.
 MILD STEEL LINER

CONTAINMENT REACTOR BUILDING

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GAS COOLED REACTORS, FOREIGN

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REMARKS

EACH REACTOR AND ITS BOILERS ARE WITHIN A CONCRETE PRESSURE VESSEL /INTEGRAL DESIGN/. CARBON DIOXIDE COOLANT FLOWS FROM BLOWERS BUILT INTO THE PRESSURE VESSEL BELOW THE FOUR BOILERS, WHICH ARE ARRANGED SYMMETRICALLY AROUND THE CORE. FLOW IS UPWARD THROUGH THE CORE.

REFERENCES

FOR BASIC DESIGN SEE CALDER

OLDBURY, FIRST U. K. CONCRETE PRESSURE VESSEL.
NUCLEAR ENG. 7, 446-8 /NOVEMBER 1962/

OLDBURY DESIGN APPRAISAL.
NUCLEAR POWER 7, 44-50 /NOVEMBER 1962/

JANUARY 1967

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GAS COOLED REACTORS. FOREIGN

DF34

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NAME/OWNER BRADWELL/CENTRAL ELECTRIC GENERATING BOARD, U.K.
DESIGNER THE NUCLEAR POWER GROUP, U.K.
OPERATOR CEGB
LOCATION BRADWELL-ON-SEA, ESSEX, ENGLAND
PURPOSE POWER
TYPE GCR, CALDER TYPE
POWER MWE(MWT) 150 538 /2-REACTOR STATION/
CRITICAL NO. 1, 1961 NO. 2, 1962.
COOLANT CARBON DIOXIDE
MODERATOR GRAPHITE, VERTICAL CHANNELS
FUEL MATERIAL URANIUM
FUEL GEOMETRY RODS, 1.155 IN, DIA. /3.3 FT. LONG
/3 FT. ACT. LENGTH/
FUEL CLADDING MAGNOX, RADIAL FINS
FUEL ENRICH. NATURAL
FUEL ASSEMBLY 8 ELEMENTS/CHANNEL /STACKED/ -
2837 CHANNELS
FUEL CHARGE 241 TONS URANIUM
SPECIFIC POWER 2.20 KW/KG URANIUM
BURNUP(REFUEL) 3000-4500 MWD/TON U
NEUTRON FLUX THERMAL AVE, 1.59×10^{13}
CORE CENTER 1.7×10^{13}
CONTROL RODS, BORON STEEL
COOLANT TEMP. INLET 180 C OUTLET 390 C
REACTOR VESSEL MILD STEEL SPHERE, 66 FT. 9 IN. DIA., 3 AND 4 IN.
THICK
CONTAINMENT REACTOR BUILDING
REMARKS POWER OPERATION IN NOVEMBER 1962

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GAS COOLED REACTORS. FOREIGN

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REFERENCES

BRADWELL: NUCLEAR POWER STATION,
NUCLEAR POWER 7, 78-105 /APRIL 1962/

BRADWELL: A HARD-WON ACHIEVEMENT
NUCLEAR ENG. 8, 164-67 /MAY 1963/

JANUARY 1967

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GAS COOLED REACTORS, FOREIGN

DF35

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NAME/OWNER	WYLFA/CENTRAL ELECTRIC GENERATING BOARD, U.K.	
DESIGNER	ATOMIC POWER GROUP, U.K.	
OPERATOR	CEGB	
LOCATION	WYLFA HEAD, N. W. WALES /ANGLESEY ISLAND/	
PURPOSE	POWER	
TYPE	GCR-CALDER TYPE, ONCE-THROUGH BOILER	
POWER MWE(MWT)	590	1870 /2-REACTOR STATION/
CRITICAL	CONSTRUCTION CONTRACT AWARDED 1964, TARGET 1969.	
COOLANT	CARBON DIOXIDE	
MODERATOR	GRAPHITE, VERTICAL CHANNELS	
FUEL MATERIAL	URANIUM	
FUEL GEOMETRY	RODS 1.10 IN. DIA./42 IN. LONG	
FUEL CLADDING	MAGNOX, HERRINGBONE FINNED	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	8 ELEMENTS/CHANNEL /STACKED/ 6150 FUEL CHANNELS	
FUEL CHARGE	595.4 TONS URANIUM	
SPECIFIC POWER	3.16 KW/KG URANIUM	
BURNUP(REFUEL)	ON-LOAD	
CONTROL	RODS, BORON STEEL OR MILD STEEL	
COOLANT TEMP.	INLET 247 C	OUTLET 414 C
COOLANT PRESS.	400 PSIA	
REACTOR VESSEL	PRESTRESSED CONCRETE, SPHERICAL INNER SHAPE 11 FT. THICK WALL	
CONTAINMENT	REACTOR BUILDING	
REMARKS	UPC CONTRACT FOR REACTOR NO. 1 WAS CANCELLED AND CONTRACT FOR 2-REACTOR STATION AWARDED TO APG IN	

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GAS COOLED REACTORS, FOREIGN

DF35

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FEB. 1964,

REFERENCES

WYLFA NUCLEAR POWER STATION

NUCLEAR ENG, 10 /77, 139-54 /APRIL 1965/

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GAS COOLED REACTORS. FOREIGN

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NAME/OWNER WEISMOOR STATION/APK, W. GERMANY

DESIGNER NOT SELECTED. SEE REMARKS,

LOCATION WEISMOOR, W. GERMANY

PURPOSE POWER

TYPE GCR-ADVANCED TYPE

POWER MWE(MWT) 40

CRITICAL PROJECT HAS BEEN CANCELED

REMARKS PROPOSALS FROM UK FOR AN AGR WERE SUBMITTED, AND
STUDY CONTRACT WAS MADE WITH GUTTEHOFFNUNGSHUTTE
STERKRADE AG AND US GA. SITE WAS TO HAVE BEEN
WEISMOOR

REFERENCES NEWS RELEASES

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BNWL=326

GAS COOLED REACTORS. FOREIGN

DF37

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NAME/OWNER	AVR PEBBLE BED REACTOR/AVR, W. GERMANY	
DESIGNER	BBC-KRUPP, W. GERMANY	
OPERATOR	AVR, WEST GERMANY	
LOCATION	JUELICH, W. GERMANY	
PURPOSE	POWER EXPERIMENT, PROTOTYPE FOR 150 MWE PLANT.	
TYPE	GCR, HIGH TEMPERATURE, PEBBLE BED	
POWER MWE(MWT)	15	46
CRITICAL	AUGUST 1966, FULL POWER TARGET SUMMER, 1967	
COOLANT	NEON-HELIUM /PROBABLY PURE HELIUM WILL BE USED/	
MODERATOR	GRAPHITE	
FUEL MATERIAL	URANIUM, THORIUM CARBIDE PEBBLES	
FUEL GEOMETRY	SMALL SPHERICAL PEBBLES 6 CM. DIA.	
FUEL CLADDING	MACHINED GRAPHITE SHELLS, GRAPHITE PLUG.	
FUEL ENRICH.	20 PER CENT U-235	
FUEL ASSEMBLY	GRAPHITE-CLAD PEBBLES 100,000 PEBBLES/CORE	
BURNUP(REFUEL)	/ON-LOAD/	
CONTROL	CONTROL OF THE COOLANT GAS= NO RODS EXCEPT SHUT-DOWN	
COOLANT TEMP.	INLET 200 C	OUTLET 850 C
COOLANT PRESS.	10 ATM.	
CONTAINMENT	DESIGN WORK IS IN PROGRESS ON PRESTRESSED CONCRETE PRESSURE VESSELS FOR LARGE UNITS. CONSTRUCTION EXPECTED BY 1967.	
REMARKS	CONSTRUCTION, TARGET 1964. THE CONCEPT WAS STUDIED BY FARRINGTON DANIELS, AND A FURTHER DEVELOPMENT BY WINNETT BOYD WAS DESIGNATED THE DANIELS-BOYD NUCLEAR STEAM GENERATOR, WHICH USED LOW-ENRICHMENT URANIUM CARBIDE WAFERS IN A POROUS GRAPHITE SHEATH FOR THE PRODUCTION OF 400 MW E.	

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THE CONCEPT WAS STUDIED FURTHER BY WINNETT BOYD IN ASSOCIATION WITH ARTHUR D. LITTLE, AS WELL AS BY SANDERSON AND PORTER AND THE OAK RIDGE LABORATORY. THE AVR PROJECT AT JULICH WAS DESIGNED AND DEVELOPED BY BBC/KRUPP OF MANNHEIM. THE USAEC HAS REQUESTED FUNDS IN ITS CONSTRUCTION AUTHORIZATION BILL FOR A COOPERATIVE PROGRAM WITH THE AVR PROJECT. AEC WOULD DEVELOP AND HAVE FABRICATED A COATED-PARTICLE REACTOR CORE FOR IRRADIATION IN THE AVR PEBBLE-BED REACTOR. A EURATOM CONTRACT WAS SIGNED IN 1964. A LONG-TERM DEVELOPMENT PROGRAM FOR THE PEBBLE-BED CONCEPT INCLUDES THE 15 MW E PLANT AS A FIRST STAGE, A SECOND STAGE REACTOR ALSO 15 MW E BUT CYCLING THE HIGH-TEMPERATURE HELIUM DIRECTLY TO A GAS TURBINE, AND A 150 MW E REACTOR AS THE FINAL STAGE, WITH A TARGET DATE OF 1970. THE REACTOR FAMILY HAS BEEN DESIGNATED THORIUM-HOCTEMPORATUR-REAKTOR /THTR/. DESIGN STUDY FOR A 200 MWE FULL-SCALE THTR WILL BE DONE IN COOPERATION WITH EURATOM.

REFERENCES

DANIELS EXPERIMENTAL POWER PILE DESIGN PROPOSAL.
MONN-188 /BOOKS I AND II

PRELIMINARY DESIGN OF A 10 MW/T/ PEBBLE-BED
REACTOR EXPERIMENT.
OAK RIDGE NATIONAL LAB.
CF-60-10-63 /NOVEMBER 1960/

DESIGN STUDY OF A PEBBLE-BED REACTOR POWER PLANT.
AP FRAAS, OTHERS
CF-60-12-5 /REV./ /MAY 1961/

CONCEPTUAL DESIGN OF THE PEBBLE-BED REACTOR
EXPERIMENT.
OAK RIDGE NATIONAL LAB.
ORNL-TM-201 /MAY 1962/

SUGGESTION FOR AN EXPERIMENTAL POWER REACTOR, AN
IMPREGNATED GRAPHITE, NITROGEN-COOLED REACTOR AND
GAS TURBINE, USING MATERIALS AND EQUIPMENT
AVAILABLE NOW.
F DANIELS
AECD-4095 /APRIL 1950. DECLASSIFIED WITH DELETIONS
DECEMBER 1955/

SMALL GAS-CYCLE REACTOR OFFERS ECONOMIC PROMISE.
F DANIELS
NUCLEONICS 14, 34-51 /MARCH 1956/

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BOYD-S ACTIVE CIRCUIT GAS REACTOR,
CANADIAN CHEM. PROCESSING 43, 54-6 /MAY 1959/

SPECIAL FEATURES OF THE BROWN BOVERI-KRUPP REACTOR
O MACHNIG, OTHERS
NUCLEAR POWER 6, 63-6 /MARCH 1961/

THE AVR HIGH TEMPERATURE GAS-COOLED REACTOR,
HW SCHMIDT
PREPRINT PAPER NO. 31. ENGINEERS JOINT COUNCIL,
NEW YORK, /1962/

HIGH TEMPERATURE REACTOR DEVELOPMENT BY BRC/KRUPP
R SCHULTEN, O MACHNIG
ATOMPRAXIS 4, 117-122 /APRIL 1963/

ENERGY OUT OF PEBBLES
P SCHULTEN
EURATOM 4, 44-48 /JUNE 1965/

THE PEBBLE BED REACTOR, GERMANY-S HIGH TEMPERATURE
GAS-COOLED PROJECT,
NUCLEAR ENG. 10, 333-34 /SEPT. 1965/

JANUARY 1967

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GAS COOLED REACTORS, FOREIGN

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NAME/OWNER AKB NUCLEAR POWER STATION/ATOMKRAFT-BAYERN, W. GERM,
 NIEDERAICHBACH STATION / BAYERNWERK REACTOR

DESIGNER SIEMENS, W. GERMANY

OPERATOR KERNKRAFTWERK NIEDERAICHBACH GMBH

LOCATION NIEDERAICHBACH, BAVARIA, W. GERMANY /ON ISAR RIVER

PURPOSE POWER PROTOTYPE

TYPE HEAVY WATER MODERATED, GCR, PRESSURE TUBE

POWER MWE(MWT) 100

CRITICAL CONSTRUCTION 1966, TARGET 1970

COOLANT CARBON DIOXIDE

MODERATOR HEAVY WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL GEOMETRY RODS

FUEL CLADDING SS

FUEL ENRICH. 1.1 PER CENT U-235

BURNUP(REFUEL) /ON-LOAD/

COOLANT TEMP. 550 C

COOLANT PRESS. 60 ATM.

CONTAINMENT DOUBLE CONTAINMENT

REMARKS THE SIEMENS DESIGN STUDY WAS COMMISSIONED BY AKB,
 FABWERKE HOECHST, AND BAVARIAN GOVERNMENT. IT HAS
 BEEN DECIDED THAT BAYERNWERKE WILL UNDERTAKE THE
 PROJECT ALONE, WITH CONSTRUCTION TO START IN 1965.
 KNK /KERNKRAFTWERK NIEDERAICHBACH/ GMBH HAS BEEN
 FORMED TO CONSTRUCT THE PLANT, AND WILL TAKE OVER
 THE OPERATION AFTER FIVE YEARS.

REFERENCES NUCLEAR POWER STATION WITH HEAVY WATER MODERATED
 PRESSURE TUBE REACTOR FOR HIGH TEMPERATURES.
 W KELLER, HANS-JOACHIM PRESUSS
 SIEMENS-Z. 37, 302-4 /APRIL 1963/

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THE AKB PROJECT FOR A GAS-COOLED HEAVY WATER POWER
REACTOR.

W KELLER

ATOMWIRTSCHAFT 8, 645-54 /DEC. 1963/

NIEDERAICHBACH NUCLEAR POWER STATION.

EURONUCLEAR 2, 281-3 /JUNE 1965/

NUCLEAR INDUSTRY DEC. 1965 P. 22

NEWS RELEASE

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GAS COOLED REACTORS. FOREIGN

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NAME/OWNER FRUSS/POLAND

PURPOSE POWER, FOR SUPERHEATING SUPERCRITICAL STEAM.

TYPE GCR, PRESSURE TUBE

POWER MWE(MWT) 1000

CRITICAL DESIGN

COOLANT GAS

MODERATOR GRAPHITE

FUEL MATERIAL URANIUM

FUEL ENRICH. NATURAL

REFERENCES FRUSS - 1000 MWE NATURAL U GAS-COOLED GRAPHITE
MODERATED PRESSURIZED REACTOR FOR SUPERCRITICAL
STEAM PARAMETERS.
J. LOPUSZYNSKI /POLISH ACAD. SCI., INST. NUCLEAR
RES. WARSAW/
PAN-543/IX/JULY 1964/

JANUARY 1967

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GAS COOLED REACTORS. FOREIGN

DF40

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NAME/OWNER HINKLEY POINT=2/CENTRAL ELECTRIC GEN. BOARD, U.K.

DESIGNER THE NUCLEAR POWER GROUP=UK

LOCATION HINKLEY POINT, SOMERSET, ENGLAND

PURPOSE POWER, TWO=REACTOR STATION

TYPE ADVANCED GCR

POWER MWE(MWT) 600

REMARKS TNGP WAS INVITED TO SUBMIT A BID FOR THE
TWO=REACTOR COMPLEX, BASED ON THE AGR DESIGN.REFERENCES NUCLEAR INDUSTRY FEB. 1966 P. 25-6
NEWS RELEASE

HEAVY WATER MODERATED REACTORS

DOMESTIC

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HEAVY WATER MODERATED REACTORS. DOMESTIC

ED01

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NAME/OWNER	SSCR /SPECTRAL SHIFT CONTROLLED REACTOR//AEC-BAW	
DESIGNER	BABCOCK AND WILCOX	
PURPOSE	POWER PROTOTYPE	
TYPE	PWR, SPECTRAL SHIFT REACTOR	
POWER MWE(MWT)	330	1074
CRITICAL	REFERENCE DESIGN	
COOLANT	HEAVY WATER - LIGHT WATER	
MODERATOR	HEAVY WATER - LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE POWDER, COMPACTED	
FUEL GEOMETRY	RODS, SWAGED. CORE ACTIVE HEIGHT 107 IN.	
FUEL CLADDING	ZIRCALOY-2 TUBES 0.025 IN. THICK. ALTERNATE SS.	
FUEL ENRICH.	3.33 PER CENT U-235 AVERAGE	
FUEL ASSEMBLY	ZONE LOADING. 220-ROD ASSEMBLY, 72 ASSEMBLIES 188-ROD ASSEMBLY WITH CENTRAL CONTROL-ROD BLADE, 25 ASSEMBLIES. 130-ROD, TRIANGULAR, PARTIAL ELEMENTS, 12 ASSEMBLIES TOTAL 109 FUEL ASSEMBLIES	
FUEL CHARGE	40,325 KG. URANIUM	
BURNUP(REFUEL)	16780 MWD/MTU	790-DAY INTERVALS
CONTROL	COMPOSITION OF COOLANT-MODERATOR MIXTURE, CONTROL AND POISON RODS.	
COOLANT TEMP.	INLET 542F	OUTLET 590F
COOLANT PRESS.	2140 PSIA	
REACTOR VESSEL	STEEL CYLINDER 13 FT. OD./29 FT. HIGH, SS INNER CLAD.	
CONTAINMENT	SPHERE, 125 FT. DIA.	
REMARKS	VARIATIONS OF THE REFERENCE DESIGN INCLUDE CORE WITH SS CLADDING, NUCLEAR PLANTS OF 154-458 MWE	

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ED01

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WITH ZIRCALOY-2 CLAD CORES, ALTERNATES USING SS CLADDING, AND A PLANT WITH A REACTOR CORE OF THORIUM OXIDE AND RECYCLED U-233 OXIDE CLAD IN ZIRCALOY. BURNS + ROE HAS STUDIED A DESALINIZATION-POWER PLANT FOR THE N.Y. ATOMIC RESEARCH AND DEVELOPMENT AUTHORITY WITH CONCENTRATION ON AN SSCR WITH THORIUM AS THE FERTILE FUEL. OTHER INTERESTS INCLUDE A PROPOSAL FOR A KEY WEST, FLORIDA, DESALINIZATION PLANT, LOS ANGELES DEPT. OF WATER AND POWER, AND SIERRA PACIFIC POWER, THE LATTER FOR A PLANT ON WALKER LAKE NEAR RENO, NEVADA.

REFERENCES

THORIUM AND URANIUM FUEL CYCLES FOR SPECTRAL SHIFT CONTROLLED PRESSURIZED WATER REACTORS.
GK RHODE, MC EDLUND
ANS THIRD ANNUAL MEETING, JUNE 1957
PAPER 4-1 /1957/

THE SPECTRAL SHIFT CONTROL REACTOR DESIGN AND ECONOMIC STUDY.
D MARS, D GANS, JR.
BAW-1241 /DECEMBER 1961/

THE SPECTRAL SHIFT CONTROL REACTOR /A VARIATION OF PWR/.
MC EDLUND
SMALL AND MEDIUM POWER REACTORS. VOL.1, P. 165-78
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA. 1961.

SPECTRAL SHIFT CONTROL REACTOR.
J COUGHLIN
ASME PREPRINT 61-PWR-6 /1961/

SPECTRAL SHIFT REACTOR.
POWER REACTOR TECH. 5/4/. 81-6 /SEPTEMBER 1962/

WATER COOLED THORIUM REACTORS
HS BARRINGER
TID-7650 /P. 172-93/ /1962/

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED02

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NAME/OWNER	HWOCR /HEAVY WATER ORGANIC COOLED REACTOR/	
DESIGNER	COMBUSTION ENGINEERING BABCOCK + WILCOX ATOMICS INTERNATIONAL	
PURPOSE	POWER	
TYPE	HEAVY WATER MODERATED, ORGANIC COOLED, PRESSURE TUBE	
POWER MWE(MWT)	500	1550
CRITICAL	REFERENCE DESIGN	
COOLANT	ORGANIC LIQUID, SANTOWAX OMP	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE OR URANIUM METAL	
FUEL GEOMETRY	ROD 0.513 IN. OD. /31 RODS/ AND 0.313 IN. /7 RODS/	
FUEL CLADDING	SAP TUBE 0.010 AND 0.016 IN. THICK	
FUEL ENRICH.	INITIAL 1.25 PER CENT U-235 OR NATURAL.	
FUEL ASSEMBLY	37-ROD ASSEMBLY, 5 ELEMENTS/PRESSURE TUBE /STACKED/ 600 PRESSURE TUBES PRESSURE TUBES HAVE AN INNER LINER OF SAP, A GAS GAP, AND AN OUTER TUBE OF ZIRCALOY-2.	
FUEL CHARGE	246,000 LBS, URANIUM DIOXIDE-98,7 TONS URANIUM	
SPECIFIC POWER	15.7 MW/MTU IN ENRICHED FUEL DESIGN.	
BURNUP(REFUEL)	20,000 MWD/MT NATURAL FUEL 5000 MWD/MT	
COOLANT TEMP.	INLET 536F	OUTLET 760F
COOLANT PRESS.	28.1 KG/SQ. CM.	
REACTOR VESSEL	HEAVY WATER TANK, VERTICAL PRESSURE TUBES	
CONTAINMENT	STEEL SPHERE	
REMARKS	REFERENCE DESIGN HAS BEEN DEVELOPED FOR ECONOMIC EVALUATION AND APPRAISAL. JOINT R+D WILL BE	

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HEAVY WATER MODERATED REACTORS. DOMESTIC

ED02

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PERFORMED ON THE CONCEPT BY CE AND AI, WITH
ASSISTANCE FROM DUPONT, UNDER AEC CONTRACT
A PRELIMINARY CONCEPTUAL DESIGN FOR A 1000 MWE
STATION HAS BEEN DONE BY CE AND AI.

REFERENCES

ORGANIC COOLED, HEAVY WATER MODERATED REACTOR
POWER PLANT CONCEPTUAL DESIGN AND EVALUATION,
VOL. II, REFERENCE PLANT DESIGN,
COMBUSTION ENG., NUCLEAR DIV.
CEND-175 /VOL. I AND II/ /MARCH 1963/

HEAVY WATER ORGANIC COOLED REACTOR
1000 MWE NUCLEAR POWER PLANT, PRELIMINARY
CONCEPTUAL DESIGN,
VOL. 2, PLANT DESCRIPTION
COMBUSTION ENG., ATOMICS INTERNATIONAL
AI-CE-MEMO-6 /VOL. 2/, OCT. 1965

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HEAVY WATER MODERATED REACTORS. DOMESTIC

ED03

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NAME/OWNER	HWCTR/HEAVY WATER COMPONENTS TEST REACTOR/AEC	
DESIGNER	E.I. DUPONT DE NEMOURS AND CO. INC.	
OPERATOR	E.I. DUPONT DE NEMOURS AND CO. INC.	
LOCATION	SAVANNAH RIVER, GEORGIA	
PURPOSE	FUEL ELEMENT TESTING, POWER REACTOR CONDITION	
TYPE	HEAVY WATER COOLED AND MODERATED, PRESSURE VESSEL	
POWER MWE(MWT)	0	60
CRITICAL	MARCH 1962	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	ZIRCONIUM-ORALLOY	
FUEL GEOMETRY	TUBES 2.3 IN. OD./1.96 IN. ID./9FT. 5 IN. LONG TARGETS WITH BORON ALONG AXIS	
FUEL CLADDING	ZIRCALOY-2 0.015 IN. THICK. ZIRCALOY-2 HOUSING TUBES	
FUEL ENRICH.	93 PER CENT U-235 IN DRIVER TUBES	
FUEL ASSEMBLY	DRIVER ELEMENTS /24/ ON OUTSIDE OF CORE, CENTER OCCUPIED BY ELEMENTS UNDER TEST, /36 POSITIONS AVAILABLE/ TEST ELEMENTS /1ST CHARGE/ ARE NATURAL U TUBES 2.06 IN. OD, AND 1.467 IN. ID. WITH 110 LB. NATURAL U/ELEMENT. /12 POSITIONS AVAILABLE/	
BURNUP(REFUEL)	OPERATING LIFE 33 MONTHS	
CONTROL	RODS, SS WITH BORON, GRAVITY DROP, /BURNABLE POISON-BORON/	
COOLANT TEMP.	INLET 214C	OUTLET 239C
COOLANT PRESS.	1000 PSI	
REACTOR VESSEL	CARBON STEEL, SS LINED, CYLINDRICAL, REMOVABLE TOP	
CONTAINMENT	PRESTRESSED REINFORCED CONCRETE /BELOW GRADE/ AND	

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED03

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CARBON STEEL /ABOVE GRADE/. CYLINDRICAL
BUILDING 70 FT. DIA./125 FT. HIGH.

REMARKS

HEAVY WATER FLOW IS DOWN THE FUEL ASSEMBLIES,
DISCHARGING AT THE BOTTOM OF THE FUEL HOUSINGS,
THEN UPWARD THROUGH THE MODERATOR SPACE AND OUT
NEAR THE TOP OF THE CORE. STEAM IS DISCHARGED TO
TO THE ATMOSPHERE. PROVISION HAS BEEN MADE
IN THE DESIGN FOR INSTALLATION OF ISOLATED COOLANT
LOOPS FOR AS MANY AS 6 OF THE TEST FUEL POSITIONS,
THE TWO CURRENTLY IN USE ARE FOR A LIQUID HEAVY
WATER-COOLED ISOLATED LOOP, AND A BOILING HEAVY
WATER COOLED ISOLATED LOOPS. AFTER ITS 33-MONTH
OPERATION PERIOD THE HWCTR WILL NO LONGER BE
OPERATED, BUT WILL BE PLACED ON STAND-BY FOR
FUTURE USE IN A POSSIBLE INTERNATIONAL ATOMIC
ENERGY PROGRAM. IT WILL NOT BE FITTED FOR AN
ORGANIC COOLANT FOR USE IN THE REDIRECTED AEC
HEAVY WATER R+D PROGRAM, NOW AIMED TOWARD THE
USE OF AN ORGANIC COOLANT.

REFERENCES

A PRELIMINARY EVALUATION OF GAS COOLING OF POWER
REACTORS MODERATED BY HEAVY WATER.

RC HOLMES, OTHERS

DP-307 /AUGUST 1958/

HEAVY WATER COMPONENTS TEST REACTOR.

SAVANNAH RIVER PLANT. PLANS AND ESTIMATE.

DP-412 /OCTOBER 1959/

HWCTR, THE SAVANNAH RIVER COMPONENTS TEST
REACTOR.

NUCLEAR ENG. 5, 221-2 /MAY 1960/

FINAL HAZARDS EVALUATION OF THE HEAVY WATER
CRITICAL TEST REACTOR /HWCTR/

LM ARNETT, OTHERS

DP-600 /DEC. 1962/

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED04

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NAME/OWNER	HEAVY WATER REACTOR STUDY-1/DU PONT	
DESIGNER	E. I. DUPONT DE NEMOURS AND CO., INC.	
PURPOSE	POWER	
TYPE	HEAVY WATER MODERATED AND COOLED, COLD PRESSURE TUBE	
POWER MWE(MWT)	491	1838
CRITICAL	STUDY	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE FUSED, COMPACTED, SWAGED WITH ZIRC-2 TUBES	
FUEL GEOMETRY	COAXIAL TUBES /MASSIVE, FULL-LENGTH/ 3 CONCENTRIC	
FUEL CLADDING	ZIRCALOY-2 0.02 IN. THICK. DIA. OF TUBES AT OUTER CLADDING 3.792 IN.	
FUEL ENRICH.	1.19 PER CENT U-235	
FUEL ASSEMBLY	FUEL BUNDLE /COAXIAL TUBES/ /15FT. LONG/ 226 FUEL POSITIONS	
FUEL CHARGE	27.1 TONS URANIUM	
SPECIFIC POWER	68 MW/MTU	
BURNUP(REFUEL)	14,000 MWD/MTU	SHUT-DOWN
CONTROL	RODS	
COOLANT TEMP.	INLET 260C	OUTLET 310C
COOLANT PRESS.	1730 PSIA	
REMARKS	ECONOMIC STUDIES	
REFERENCES	AN EVALUATION OF HEAVY WATER MODERATED POWER REACTOR OF BABCOCK, OTHERS. DP-830 /JUNE 1963/	

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED05

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NAME/OWNER	HEAVY WATER REACTOR STUDY-2/DU PONT	
DESIGNER	E. I. DUPONT DE NEMOURS AND CO., INC.	
OPERATOR	STUDY	
PURPOSE	SEA-WATER DISTILLATION	
TYPE	HEAVY WATER MODERATED AND COOLED, VERTICAL PRESSURE TUBES	
POWER MWE(MWT)	550	3500
CRITICAL	STUDY	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE COMPACTED SWAGED WITH ZIRC-2 TUBES	
FUEL GEOMETRY	CONCENTRIC TUBES /COAXIAL TUBES/-3, DIA, OUTER CLAD TUBES 3.7 IN. OD.	
FUEL CLADDING	ZIRCALLOY-2	
FUEL ENRICH.	1.2 PER CENT U-235	
FUEL ASSEMBLY	3 COAXIAL TUBES 7 1/2 FT. LONG 420 ASSEMBLIES	
FUEL CHARGE	APPROX. 63 TONS URANIUM	
BURNUP(REFUEL)	15000 MWD/MTU	INTERIM 1/3 REPLACEMENT
CONTROL	RODS, TOP-MOUNTED CONTROL, GRAVITY SAFETY	
COOLANT TEMP.	320C	
COOLANT PRESS.	1700 PSI	
REACTOR VESSEL	SS TANK, WELDED-IN PRESSURE TUBES	
CONTAINMENT	CONVENTIONAL LOW-LEAKAGE STEEL SHELL	
REMARKS	PRIMARY COOLANT SYSTEM /8 LOOPS/, COOLANT DISTRIBUTION TO PRESSURE TUBES BY HEADERS AND PIG TAILS. ALL PRIMARY PIPING AND EQUIPMENT IS CARBON STEEL. STUDY IS FOR APPLICATION TO SEA-WATER DISTILLATION PLANT.	

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HEAVY WATER MODERATED REACTORS. DOMESTIC

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REFERENCES

HEAVY WATER REACTORS FOR SEA-WATER DISTILLATION
PLANTS.
DS ST. JOHN, OTHERS.
DP-866 /JAN, 1964/

JANJARY 1967

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HEAVY WATER MODERATED REACTORS. DOMESTIC

ED06

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NAME/OWNER	HEAVY WATER REACTOR STUDY-3/DU PONT	
DESIGNER	E. I. DUPONT DE NEMOURS AND CO., INC.	
PURPOSE	SEA WATER DISTILLATION-STUDY	
TYPE	HEAVY WATER MODERATED, ORGANIC COOLED, PRESSURE TUBES /COLD/	
POWER MWE(MWT)	2660	8300
CRITICAL	STUDY	
COOLANT	ORGANIC LIQUID	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM CARBIDE	
FUEL GEOMETRY	CONCENTRIC TUBES, 10 FT. LONG, OUTER TUBE, CLAD, 3.20 IN. DIA.	
FUEL ASSEMBLY	CONCENTRIC TUBES 1400 ASSEMBLIES	
BURNUP(REFUEL)	8500 MWD/TON	ON-LINE, 1 POSITION AT A TIME
CONTROL	RODS	
COOLANT TEMP.	INLET 280C	OUTLET 380C
COOLANT PRESS.	300 PSI	
REACTOR VESSEL	CALANDRIA, ALUMINUM TUBES, TUBE SHEET AND SHELL. AXIAL AND RADIAL THERMAL SHIELDS ARE ANNULAR CARBON STEEL TANKS.	
CONTAINMENT	CONVENTIONAL STEEL VESSEL, INNER CONCRETE SHADOW SHIELD.	
REMARKS	THE PRESSURE TUBES OF ZIRCONIUM-NIOBIUM ALLOY ARE LINED WITH A DIFFUSION BARRIER. AN 0.120-IN. ANNULUS OF INERT GAS IS PROVIDED BETWEEN THE PRESSURE TUBE AND THE CALANDRIA TUBE. IN THE OPTIMUM FUEL ASSEMBLY DESIGN, THERE MAY BE A SOLID CENTRAL ROD INSTEAD OF A SMALL DIA. TUBE. PROTOTYPE PLANT DESIGN IS ON 3500 MWT.	
REFERENCES	HEAVY WATER REACTORS FOR SEA WATER DISTILLATION PLANTS.	

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HEAVY WATER MODERATED REACTORS. DOMESTIC

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DS ST. JOHN, OTHERS.
DP-866 /JAN, 1964/

JANUARY 1967

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HEAVY WATER MODERATED REACTORS. DOMESTIC

ED07

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NAME/OWNER HEAVY WATER REACTOR STUDY-4/DU PONT

DESIGNER E. I. DUPONT DE NEMOURS AND CO., INC.

PURPOSE POWER, U-233/THORIUM FUEL CYCLE.

TYPE HEAVY WATER MODERATED AND COOLED, PRESSURE TUBE

POWER MWE(MWT) 981

CRITICAL STUDY

COOLANT HEAVY WATER

MODERATOR HEAVY WATER

FUEL MATERIAL THORIUM METAL WITH 1.5 PER CENT U-233 AND THORIUM
BLANKET

FUEL GEOMETRY TUBES. BLANKET THORIUM SLUGS

FUEL ASSEMBLY CONCENTRIC TUBES AND BLANKET SOLID ELEMENTS.
678 FUEL POSITIONS

FUEL CHARGE 103 TONS THORIUM + 1540 KG, U-233

CONTROL RODS

COOLANT TEMP. INLET 264C OUTLET 304C

COOLANT PRESS. 500 PSI A

REMARKS U-233 THORIUM FUEL CYCLE STUDY, CONCEPT, FURTHER
DEVELOPMENT IS PROPOSED TO THE AEC.

REFERENCES THORIUM-FUELED HEAVY WATER MODERATED POWER
REACTORS
OF BABCOCK ET AL.
DP-864 /1963/

HEAVY WATER REACTORS FOR BREEDING WITH THORIUM
DS ST. JOHN, JW WADE
NUCLEONICS 22,54-57 /SEPT. 1964/

JANUARY 1967

BNWL-326

HEAVY WATER MODERATED REACTORS, DOMESTIC

ED08

* * * * *

NAME/OWNER	PRTR /PLUTONIUM RECYCLE TEST REACTOR/ /AEC
DESIGNER	GENERAL ELECTRIC COMPANY
OPERATOR	PACIFIC NORTHWEST LAB., BATTELLE MEMORIAL INST.
LOCATION	HANFORD, RICHLAND, WASHINGTON
PURPOSE	POWER, PLUTONIUM RECYCLE DEMONSTRATION
TYPE	HEAVY-WATER MODERATED AND COOLED, PRESSURE TUBE /CALANDRIA/
POWER MWE(MWT)	0 70
CRITICAL	DECEMBER 1960
COOLANT	HEAVY WATER
MODERATOR	HEAVY WATER
FUEL MATERIAL	FIRST CORE URANIUM DIOXIDE WITH PLUTONIUM-ALUMINUM SPIKE ASSEMBLIES. LATER, UNIFORM LOADING WITH PLUTONIUM/URANIUM DIOXIDE.
FUEL GEOMETRY	RODS 0.504 IN. DIA./7 FT. 4 IN. LONG. MARK 2 CONCENTRIC TUBES.
FUEL CLADDING	ZIRCALOY-2 0.030 IN. THICK
FUEL ASSEMBLY	19-ROD ASSEMBLIES, 85 PROCESS TUBES. CORE 1, 52 URANIUM DIOXIDE ASSEMBLIES 33 SPIKE ELEMENTS 1963, 44 URANIUM/PLUTONIUM OXIDE ELEMENTS 22 ALUMINUM-PLUTONIUM /TEST/ AND 19 URANIUM DIOXIDE /TEST/ ELEMENTS.
SPECIFIC POWER	15 KW/KG URANIUM DIOXIDE
BURNUP(REFUEL)	URANIUM DIOXIDE ELEMENTS 5000-8000 MWD/T PLUTONIUM-ALUMINUM ELEMENTS 50 PER CENT
NEUTRON FLUX	THERMAL AVE. 8.3×10^{13} /RADIAL/ FAST AVE. 2.7×10^{13} /RADIAL
CONTROL	MODERATOR LEVEL, SHIM CONTROL BY ABSORBER ELEMENTS
COOLANT TEMP.	INLET 478F OUTLET 530F
COOLANT PRESS.	1050 PSIG

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED08

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REACTOR VESSEL ALUMINUM CALANDRIA TANK CONTAINING THE MODERATOR WITH FUEL CHANNELS AND PROCESS TUBES MOUNTED VERTICALLY. PROCESS TUBES ARE ZIRCALOY-2 WITH GAS-GAP THERMAL INSULATIONS.

CONTAINMENT ALL-WELDED STEEL CYLINDER, HEMISPHERICAL TOP, 80 FT. DIA. AND 120 FT. HIGH

REMARKS THERE ARE 85 FUEL CHANNELS, VERTICALLY MOUNTED WITHIN THE CALANDRIA, THE INNER PROCESS TUBE IS OF ZIRCALOY-2 AND CONTAINS THE FUEL ELEMENTS, INITIAL LOADING CONTAINED TWO TYPES OF ELEMENTS, THE MARK I ELEMENT IS A 19-ROD CLUSTER ASSEMBLY, THE MARK II ELEMENT IS COMPOSED OF A ROD SURROUNDED BY TWO CONCENTRIC ANNULAR RINGS IN ZIRCALOY-2 CLADDING. HEAVY WATER FLOWS VERTICALLY UPWARD WITHIN THE PROCESS TUBES, SHUTDOWN IN JUNE 1962 FOR REFUELING.

REFERENCES THE PLUTONIUM RECYCLE PROGRAM, A RESUME OF THE CONCEPT, PROGRAM, AND FACILITIES.
HANFORD ATOMIC PROD. OPN.
HW-50700 /JUNE 12, 1957/

THE PLUTONIUM RECYCLE TEST REACTOR FINAL SAFEGUARDS ANALYSIS.
NG WITTENBROCK, OTHERS
HW-61236 /OCTOBER 1959/

THE PLUTONIUM RECYCLE TEST REACTOR,
POWER REACTOR TECHNOLOGY 3,53-57 /JUNE 1960/

MEASURED PHYSICS PARAMETERS, DESIGN FEATURES, AND OPERATING CHARACTERISTICS OF PRTR.
JR TRIPLETT, RE PETERSON
POWER REACTOR EXPERIMENTS VOL. 2, PP. 213-26
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1962

JANUARY 1967

BNWL#326

HEAVY WATER MODERATED REACTORS. DOMESTIC

ED09

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NAME/OWNER	PHWR STUDY/GNEC-AEPSC	
DESIGNER	GENERAL NUCLEAR ENGINEERING CORPORATION	
PURPOSE	STUDY	
TYPE	HEAVY WATER MODERATED, VERTICAL PRESSURE TUBE /COLD/	
POWER MWE(MWT)	489	1850
CRITICAL	STUDY	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.23 IN. ID. AND 0.500 IN. OD.	
FUEL GEOMETRY	HOLLOW RODS	
FUEL CLADDING	ZIRCONIUM-NIOBIUM ALLOY 0.015 IN. THICK	
FUEL ENRICH.	1.43 PER CENT U-235	
FUEL ASSEMBLY	19-ROD BUNDLE, 4.5 FT. LONG. 4 BUNDLES ARE STACKED END TO END IN EACH OF THE 560 ZIRCONIUM-NIOBIUM PRESSURE TUBES. 560 FUEL POSITIONS	
FUEL CHARGE	51.4 METRIC TONS URANIUM	
SPECIFIC POWER	35.5 MW/TON U	
BURNUP(REFUEL)	19.700 MWD/MTU	/ON-LINE REFUELING/
CONTROL	BALL COLUMNS, HYDRAULICALLY ACTUATED BORON SS	
COOLANT TEMP.	INLET 257 C	OUTLET 302 C
COOLANT PRESS.	1760 PSIA	
REACTOR VESSEL	SS 22 FT. 4 IN. DIA./21 FT. HIGH HEAVY WATER TANK, 1.25 IN. WALL THICKNESS.	
CONTAINMENT	SPHERICAL STEEL SHELL, 165 FT. DIA.	
REMARKS	STUDY MADE FOR ECNG	
REFERENCES	HEAVY WATER MODERATED REACTORS EVALUATION STUDY.	

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HEAVY WATER MODERATED REACTORS. DOMESTIC

ED09

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AMERICAN ELECTRIC POWER SERVICE CORP. AND GENERAL
NUCLEAR ENGINEERING CORP., EAST CENTRAL NUCLEAR
GROUP INC.
NP-12344 /OCT, 15, 1962. VOL. 1, 2 AND 3.

JANUARY 1967

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HEAVY WATER MODERATED REACTORS. DOMESTIC

ED10

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NAME/OWNER	BHWR STUDY/GNEC-AEPSC
DESIGNER	GENERAL NUCLEAR ENGINEERING CORPORATION
PURPOSE	POWER
TYPE	HEAVY WATER COOLED AND MODERATED, BWR, PRESSURE TUBE
POWER MWE(MWT)	1697
CRITICAL	STUDY
COOLANT	BOILING HEAVY WATER
MODERATOR	HEAVY WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS, CORED, CYLINDRICAL, 0.50 IN. OD./0.20 IN. ID.
FUEL GEOMETRY	ROD
FUEL CLADDING	ZIRCONIUM-NIOBIUM TUBES, 0.015 IN. WALL THICKNESS
FUEL ENRICH.	1.352 PER CENT U-235
FUEL ASSEMBLY	19-ROD BUNDLES, 4 BUNDLES /ACT. LENGTH 18 FT./ IN EACH ZIRCONIUM-NIOBIUM ALLOY PRESSURE TUBE 700 PRESSURE TUBES IN CORE
FUEL CHARGE	77.5 TONS URANIUM DIOXIDE
SPECIFIC POWER	24.8 MW/TON U
BURNUP(REFUEL)	19,620 MWD/MTU /ON-POWER, FUEL SHUFFLING/
CONTROL	HY-BALL COLUMNS
COOLANT PRESS.	1100 PSIA
REACTOR VESSEL	24-FT. DIA. VESSEL, PENETRATED BY PRESSURE TUBES, /STAINLESS STEEL/
CONTAINMENT	SPHERICAL STEEL SHELL, 160 FT. DIA.
REMARKS	STUDY FOR ECNG. CORE CONSISTS OF 700 PRESSURE TUBES SURROUNDED BY MODERATOR, THE HOT BOILING COOLANT IS INSULATED FROM THE MODERATOR AND PRESSURE TUBE BY 4 ANNULI OF STAGNANT HEAVY WATER LOCATED INSIDE THE PRESSURE TUBE BETWEEN THE FUEL

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED10

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BUNDLE AND THE TUBE.

REFERENCES

HEAVY WATER MODERATED REACTORS EVALUATION STUDY,
AMERICAN ELECTRIC POWER SERVICE CORP., GENERAL
NUCLEAR ENG. CORP.,
NP-12344 /OCT. 15, 1962/ VOL. 1, 2 AND 3.

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED11

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NAME/OWNER	HEAVY WATER REACTOR STUDY/ORNL BOILING LIGHT WATER COOLED	
DESIGNER	OAK RIDGE NATIONAL LABORATORY	
PURPOSE	POWER AND WATER DESALINIZATION	
TYPE	HEAVY WATER MODERATED, LIGHT WATER COOLED, VERTICAL PRESSURE TUBE /CALANDRIA/.	
POWER MWE(MWT)	8333	
CRITICAL	REFERENCE DESIGN	
COOLANT	BOILING LIGHT WATER	
MODERATOR	HEAVY WATER, GRAPHITE REFLECTOR.	
FUEL MATERIAL	URANIUM DIOXIDE, VIBRATORY COMPACTED RINGS ABOUT 0.6 IN. THICK	
FUEL GEOMETRY	2 CONCENTRIC TUBES 4.326 IN. OD./72 IN. LONG	
FUEL CLADDING	ZIRCALOY-2 0.020 IN. THICK	
FUEL ASSEMBLY	STRING OF ELEMENTS IN EACH TUBE, ACTIVE CORE LENGTH 28.5 FT. 1308 PRESSURE TUBES	
FUEL CHARGE	747 TONS URANIUM	
BURNUP(REFUEL)	7000 MWD/MTU	FUEL SHUFFLING 10 ELEMENTS/DAY
COOLANT TEMP.	INLET 464 F	OUTLET 486 F
COOLANT PRESS.	INLET 720 PSIA	OUTLET 620 PSIA
REACTOR VESSEL	CUBICAL ALUMINUM-CLAD STEEL CALANDRIA VESSEL, 34 FT. ON SIDE, CONTAINING COLD MODERATOR AND GRAPHITE REFLECTOR, ALUMINUM CALANDRIA TUBES, GAS-GAP INSULATION FROM PRESSURE TUBES.	
CONTAINMENT	SEPARATE CYLINDRICAL BUILDING FOR EACH REACTOR OF A COMPLEX STATION. DOUBLE CONTAINMENT, WITH ZONE BETWEEN THE TWO BARRIERS AT A NEGATIVE PRESSURE.	
REMARKS	REFERENCE DESIGN PREPARED FOR A DUAL PURPOSE FACILITY USING THREE 8333 MWT REACTORS AND PRODUCING 2-BILLION GAL. WATER/DAY. PLANT DESIGNS WERE PREPARED FOR ORNL BY SARGENT AND LUNDY FOR A	

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED11

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25000 MWT STATION AND A 3500 MWT REACTOR.

REFERENCES

A LARGE DESALINIZATION REACTOR BASED ON CURRENT
TECHNOLOGY,

I SPIEWAK

NUCLEONICS 21, 64, 66, 68 /JULY 1963/

SALINE WATER CONVERSION POWER REACTOR PLANTS

SARGENT AND LUNDY /FOR OAK RIDGE NATIONAL
LABORATORY/

SL-1998 /JANUARY 11, 1963/

JANUARY 1967

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED12

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NAME/OWNER	PARR SHOALS PLANT / CVNPA CVTR, CAROLINAS-VIRGINIA TUBE REACTOR	
DESIGNER	WESTINGHOUSE ELECTRIC CORPORATION	
OPERATOR	CAROLINAS-VIRGINIA NUCLEAR POWER ASSOCIATES /CNVA/	
LOCATION	PARR SHOALS, S. C.	
PURPOSE	POWER DEMONSTRATION, PROTOTYPE	
TYPE	HEAVY WATER MODERATED AND COOLED, PRESSURE TUBE /U-TUBE/	
POWER MWE(MWT)	17	56
CRITICAL	MARCH 1963	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.43 IN. DIA./0.636 IN. LONG /OUTER ZONE/ AND 0.53 IN. /INNER/	
FUEL GEOMETRY	RODS, ACTIVE LENGTH 95.4 IN.	
FUEL CLADDING	ZIRCALOY-4 0.0215 IN. THICK + ZIRCALOY-4 WIRE WRAPPING	
FUEL ENRICH.	OUTER ZONE, 2.0 PER CENT U-235 INNER ZONE, 1.5 PER CENT U-235	
FUEL ASSEMBLY	19-ROD BUNDLE /HEX-COOLANT-FLOW BAFFLE AROUND BUNDLE/ 72 FUEL ASSEMBLIES /1 ASSEMBLY IN EACH END OF U-TUBE/ 36 PRESSURE TUBES /ZIRCALOY-4 INSIDE CORE, SS OUTSIDE/	
FUEL CHARGE	3280 KG, URANIUM	
BURNUP(REFUEL)	8404 MWD/TON U	CYCLIC REFUELING /INITIAL CORE AVE./
CONTROL	RODS, BORON-SS AND SS	
COOLANT TEMP.	INLET 505 F	OUTLET 541 F
COOLANT PRESS.	1500 PSIA	

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED12

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REACTOR VESSEL SS MODERATOR TANK WITH HEAVY WATER, UPRIGHT
CYLINDER.

CONTAINMENT RIGHT VERTICAL CYLINDER, FLAT BASE, HEMISPHERICAL
DOME, STEEL-LINED REINFORCED CONCRETE, 58 FT. ID.
AND 114 FT. HIGH

REMARKS COLD TUBE DESIGN, IN WHICH THE PRESSURE TUBE IS
INSULATED FROM THE HIGH TEMPERATURE CIRCULATING
FLUID. PHYSICS TESTS, MAINTENANCE SHUT-DOWN IN
JUNE-JULY 1964, POSSIBLE POWER PRODUCTION TARGET
JULY 1964. A LARGE PLANT DESIGN HAS BEEN
DEVELOPED.

REFERENCES CAROLINAS-VIRGINIA TUBE REACTOR REFERENCE
DESIGN II WESTINGHOUSE ELECTRIC CORP.,
STONE + WEBSTER ENG. CORP.
CVNA-40 /DECEMBER 16, 1959/

CVTR-PRESSURE-TUBE REACTOR,
PG DEHUFF
WESTINGHOUSE ENGR. 31. 98-102 /JULY 1961/

CAROLINAS-VIRGINIA NUCLEAR POWER ASSOCIATES.
FINAL HAZARDS SUMMARY REPORT. PART B. LICENSE
APPLICATION.
CVNA-90 /1962/

CAROLINAS-VIRGINIA PRESSURE TUBE REACTOR.
NUCLEAR ENERGY, PP. 424-7, NOVEMBER 1962

DESIGN PRACTICE, THE CAROLINAS-VIRGINIA TUBE
REACTOR.
POWER REACTOR TECH. 6. 63-81 /FALL 1963/

THE CAROLINAS-VIRGINIA TUBE REACTOR.
NUCLEONICS 23, 50-51 /MAY 1965/

JANUARY 1967

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED13

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NAME/OWNER CVNA LARGE PLANT / WEST
 DESIGNER WESTINGHOUSE ELECTRIC CORPORATION
 PURPOSE DESIGN STUDY, POWER
 TYPE HEAVY WATER MODERATED AND COOLED, PRESSURE TUBE,
 COLD TUBE U-TUBE

POWER MWE(MWT) 300 1136 AS IN CASE IV

CRITICAL DESIGN

COOLANT HEAVY WATER

MODERATOR HEAVY WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS 0.5 IN. DIA.

FUEL GEOMETRY RODS, 0.54 IN. OD. BY 16.03 FT. ACTIVE LENGTH

FUEL CLADDING ZIRCALOY

FUEL ENRICH. SEE REMARKS

FUEL ASSEMBLY 37-ROD CLUSTER /SEE REMARKS/
 5 ELEMENTS PER PRESSURE TUBE
 384 PRESSURE TUBES IN REACTOR

SPECIFIC POWER 14.8 MWT/MTU

COOLANT TEMP. INLET 488 F OUTLET 570.8 F

COOLANT PRESS. 1480 PSIA

REACTOR VESSEL SS MODERATOR TANK, VERTICAL CYLINDER.

REMARKS FOUR CASES WERE STUDIED. CASE 1, USING NATURAL URANIUM DIOXIDE FUEL IN 19-ROD CLUSTERS. CASE 2, ENRICHED URANIUM DIOXIDE IN 19-ROD CLUSTERS. CASE 3, NATURAL FUEL IN 37-ROD CLUSTERS. AND CASE 4, ENRICHED FUEL IN 37-ROD CLUSTERS. PRIMARY SYSTEM PRESSURE IS 1000 PSIA FOR THE NATURAL URANIUM SYSTEMS, TO MINIMIZE THE WALL THICKNESS OF THE PRESSURE TUBES AND FUEL-ROD CLADDING

REFERENCES CAROLINAS-VIRGINIA TUBE REACTOR, LARGE PLANT STUDY
 WESTINGHOUSE ELEC. CORP.
 RG MC GRATH, ED,
 CVNA-184 /JUNE 1963/

ED13

JANUARY 1967

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HEAVY WATER MODERATED REACTORS, DOMESTIC

ED13

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HEAVY WATER REACTORS. LARGE PLANT STUDIES.
POWER REACTOR TECHNOLOGY 7. 401-6 /FALL 1964/

HEAVY WATER MODERATED REACTORS

FOREIGN

JANUARY 1967

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF01

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NAME/OWNER NPD-2/AECL, ONTARIO HYDRO, CANADA
 NUCLEAR POWER DEMONSTRATION-2

DESIGNER CGE-CANADA

OPERATOR ONTARIO HYDRO

LOCATION DES JOACHIMS, ONTARIO, CANADA

PURPOSE POWER DEMONSTRATION

TYPE HEAVY WATER MODERATED AND COOLED, HORIZONTAL
 PRESSURE TUBE /CALANDRIA/

POWER MWE(MWT) 20 83

CRITICAL APRIL 1962

COOLANT HEAVY WATER

MODERATOR HEAVY WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS 2.38 CM. DIA./2.11 CM.
 LONG

FUEL GEOMETRY ROD 2.54 CM. DIA./49.5 CM. LONG

FUEL CLADDING ZIRCALOY-2 TUBES 0.025 IN. THICK

FUEL ENRICH. NATURAL

FUEL ASSEMBLY 7-ROD BUNDLE
 132 PRESSURE TUBES

FUEL CHARGE 15,000 KG. URANIUM

SPECIFIC POWER 5.55 KW/KG. URANIUM

BURNUP(REFUEL) 5400 MWD/T

NEUTRON FLUX THERMAL AVE. 2.6×10^{13}
 FAST AVE. 1.6×10^{13}

CONTROL 1 BOOSTER ROD, ADJUSTABLE MODERATOR LEVEL,

COOLANT TEMP. INLET 252 C OUTLET 277 C

COOLANT PRESS. INLET 78 KG/SQ.CM. OUTLET 72 KG/SQ.CM.

REACTOR VESSEL CALANDRIA /TUBE-IN-SHELL SYSTEM/. CALANDRIA TUBES

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF01

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ARE ALUMINUM, PRESSURE TUBES ARE ZIRCALOY-2,
HORIZONTAL CYLINDER, ALUMINUM, DOUBLE-WALLED,

CONTAINMENT REACTOR VAULT, CONCRETE

REMARKS A 68 MWE REACTOR HAS ALSO BEEN STUDIED, A DESIGN
FOR AN OFF-THE-SHELF CONCEPT, HWR-80, HAS BEEN
MADE. THE CANADIAN ATOMIC ENERGY OF CANADA PLANS
TO CONVERT NPD TO A LIGHT-WATER COOLED, DIRECT
CYCLE PLANT BY 1967.

REFERENCES THE CANADIAN NPD-2 POWER STATION.
IN MACKAY
SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY 8, 313-21 /1958/

DESIGN OF NPD AND CANDU
IL WILSON
AECL-799 /PAPER NO. 11/ /1959/

NPD ON THE LINE, REACTOR FILE NO. 13,
NUCLEONICS 20, /FACING P. 46/ /NOVEMBER 1962/

NPD-2, CANADA'S PROTOTYPE POWER REACTOR,
A WYATT
NUCLEAR ENERGY, MAY 1962, PP. 192-201

UPRATED NPD OR HWR-80
JL OLSEN
AECL-1599 /PP. 43-53/ /SEPTEMBER 1962/

HEAVY WATER MODERATED NATURAL URANIUM POWER
REACTORS,
JL GRAY, OTHERS
AECL-1646 /OCTOBER 1962/

HWR- OFF-THE-SHELF DESIGN FOR NUCLEAR POWER,
DAB CHASE
CANADIAN NUCLEAR TECHNOLOGY 1 /6/, 31-8 /1962/

NUCLEAR POWER DEMONSTRATION GENERATING STATION,
FINAL HAZARDS REPORT,
CANADIAN GENERAL ELECTRIC CO.
AECL-1813 /AUG. 1963/

JANUARY 1967

BNWL 326

HEAVY WATER MODERATED REACTORS, FOREIGN

EF02

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NAME/OWNER	ONTARIO HYDRO/ONTARIO HYDRO, AECL, CANADA PICKERING NUCLEAR GENERATING STATION		
DESIGNER	AECL AND ONTARIO-HYDRO, CANADA		
OPERATOR	HYDROELECTRIC POWER COMM. OF ONTARIO /ONTARIO-HYD/		
LOCATION	FAIRPORT, LAKE ONTARIO, CANADA		
PURPOSE	POWER		
TYPE	HEAVY WATER MODERATED AND COOLED, HORIZONTAL PRESSURE TUBE, HOT, 2-REACTOR STATION		
POWER MWE(MWT)	508	1742	/PER REACTOR/ TWO-REACTOR STATION
CRITICAL	NO.1 TARGET 1970 NO.2 TARGET 1971		
COOLANT	HEAVY WATER PRESSURIZED		
MODERATOR	HEAVY WATER, COLD, HEAVY WATER REFLECTOR		
FUEL MATERIAL	URANIUM DIOXIDE PELLETS		
FUEL GEOMETRY	RODS 0.6 IN. DIA. OVER CLAD		
FUEL CLADDING	ZIRCALOY TUBES 0.41 MM. WALL THICKNESS		
FUEL ENRICH.	NATURAL		
FUEL ASSEMBLY	29-ROD BUNDLE 12 BUNDLES/CHANNEL 390 CHANNELS		
FUEL CHARGE	105 TONS URANIUM DIOXIDE		
SPECIFIC POWER	18.8 KW/KG		
BURNUP(REFUEL)	8000 MWD/T		
NEUTRON FLUX	THERMAL MAX. 1X10 E+14		
CONTROL	RODS		
COOLANT TEMP.	INLET 249 C	OUTLET 293 C	
COOLANT PRESS.	1285.PSIA		
REACTOR VESSEL	HORIZONTAL SS CALANDRIA WITH ZIRCALOY TUBES		

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HEAVY WATER MODERATED REACTORS. FOREIGN

EF02

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ROLLED INTO SS END FITTINGS. COOLANT TUBE BORE
IS 10 CM,

CONTAINMENT

VERTICAL REINFORCED CONCRETE CYLINDER, ELLIPSOID
DOME, CALANDRIA VAULT.
PRESSURE-RELEASE SYSTEM.
INDIVIDUAL BUILDINGS WILL HOUSE THE TWO REACTORS.
THE CONTAINMENT SYSTEM DEPENDS ON PRESSURE
REDUCTION BY MEANS OF A LARGE VACUUM BUILDING,
TO WHICH ALL REACTORS ARE CONNECTED BY DUCTWORK.
THE BUILDING WILL BE PERMANENTLY EXHAUSTED TO
1 PSIA. A TANK CONTAINING 350,000 CU. FT. WATER
AT TOP OF THE VACUUM BUILDING WILL PROVIDE A
DOUSING SPRAY IF THE PRESSURE RISES ABOVE 6.2 PSIA

REMARKS

ZIRCONIUM-NIOBIUM ALLOY MAY BE USED FOR PRESSURE
TUBES. CONSTRUCTION DECISION HAS BEEN REACHED.
THE INSIDE DIAMETER OF THE COOLANT TUBES WILL BE
INCREASED FROM 8.26 CM. /DOUGLAS POINT/ TO ABOUT
10 CM., WITH A REDUCTION IN NO. OF TUBES BY ABOUT
1/3. FULL BUNDLES COMPOSED OF 28 ELEMENTS, WITH
SAME DIAMETER AS THOSE OF DOUGLAS POINT, WILL BE
ACCOMMODATED. ALTERNATE 22-ROD ELEMENT MAY BE
DEVELOPED FOR LATER LOADINGS.

REFERENCES

POWER REACTOR DEVELOPMENT EVALUATION. A
SUMMARY REPORT BY A COMMITTEE OF AECL STAFF,
AECL-1730 /MAY 1, 1963/

STUDIES OF CANDU-TYPE REACTORS IN THE 500 MWE
RANGE.

IL WILSON, CE BEYNON, OTHERS
THIRD U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964, A/CONF.28/P/6

DESIGN PARAMETERS FOR 500 MW CANDU REACTOR.
IL WILSON, CE BEYNON, OTHERS
CANADIAN NUCLEAR TECHNOLOGY 3/4/.38-42 /FALL 1964/

THE PICKERING NUCLEAR GENERATING STATION
CE BEYNON
AECL-2214 /APRIL 1965/

HEALTH PHYSICS MAY 1966 P. 725-6
NEWS NOTE

PROGRESS REPORT ON THE PICKERING GENERATING
STATION
WG MORRISON
AECL-2558 /AUG. 1966/

JANUARY 1967

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF03

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NAME/OWNER	CANDU/AECL, CANADA DOUGLAS POINT	
DESIGNER	AECL, ONTARIO-HYDRO, CANADA	
OPERATOR	HYDROELECTRIC POWER COMM. OF ONTARIO /ONTARIO-HYD/	
LOCATION	DOUGLAS POINT, LAKE HURON, ONTARIO, CANADA	
PURPOSE	POWER	
TYPE	HEAVY WATER MODERATED AND COOLED, PRESSURE TUBE /HORIZONTAL/, CALANDRIA	
POWER MWE(MWT)	203	655
CRITICAL	OCT. 1966, FULL POWER JAN. 1967	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 14,24 MM.DIA./20 MM. LONG 24 PER ROD,	
FUEL GEOMETRY	ROD 0.6 IN. DIA. OVERCLAD, 19.5 IN. LONG	
FUEL CLADDING	ZIRCALOY-2 TUBES 0.015 IN. THICK, 0.6 IN. OD.	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	19-ROD BUNDLES, 12/PRESSURE TUBE 306 PRESSURE TUBES	
FUEL CHARGE	92,000 LB. URANIUM	
BURNUP(REFUEL)	8400 MWD/TU	5 BUNDLES/DAY ON-LOAD
NEUTRON FLUX	THERMAL AVE. 1.8 E+14 FAST AVE. 1.6 E+14	
CONTROL	RODS, BOOSTER AND ABSORBER, MODERATOR LEVEL,	
COOLANT TEMP.	INLET 480 F	OUTLET 560 F
COOLANT PRESS.	INLET 1480 PSI	OUTLET 1310 PSI
REACTOR VESSEL	CALANDRIA SS SHELL, ZIRCALOY-2 CALANDRIA AND PRESSURE TUBES.	

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EF03

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CALANDRIA 19 FT 8 IN. ID. / 16 FT. 5 IN. LONG.

CONTAINMENT CIRCULAR BUILDING, CONCRETE WALLS, HEMISPHERICAL, STEEL DOME.

REMARKS COOLANT FLOW IS IN OPPOSITE DIRECTIONS IN ADJACENT TUBES. BOILING CORES FOR THE CANDU CONCEPT HAVE ALSO BEEN STUDIED, AS WELL AS A REACTOR OF INTERMEDIATE SIZE. ONTARIO HYDRO IS CONSIDERING A COMPLEX OF FOUR 450 MWE CANDU-TYPE REACTORS, WITH THE FIRST TWO PLANNED FOR 1970. CANADIAN GE HAS PRODUCED A PRACTICAL DESIGN FOR AN 1800 MW NUCLEAR POWER PLANT, HWR-1800, BASED ON CANDU.

REFERENCES BASIC CONSIDERATIONS IN THE DESIGN OF A FULL SCALE HEAVY WATER AND NATURAL URANIUM POWER REACTOR.

W.B. LEWIS

AECL-785 /MARCH 28, 1959/

STATUS REPORT ON THE DOUGLAS POINT PROJECT.
DLS BATE

AECL-1599 /P. 54-68/ /SEPTEMBER 1962/

HEAVY WATER MODERATED NATURAL URANIUM POWER REACTORS.

J.L. GRAY, OTHERS

AECL-1646 /OCTOBER 1962/

DOUGLAS POINT NUCLEAR GENERATING STATION.
ATOMIC ENERGY OF CANADA LTD.

AECL-1596 /OCTOBER 1962/

DESIGN AND COST ESTIMATE OF A MULTIPLE UNIT HEAVY WATER MODERATED AND COOLED NUCLEAR POWER PLANT.

V.L. WILLIAMS /CANADIAN GENERAL ELECTRIC CO., LTD./
CANADIAN NUCLEAR ASSOCIATION-INTERNATIONAL
CONFERENCE, MONTREAL, MAY 1963

NUCLEAR ENG. 8, 343 /SEPTEMBER 1963/ ABSTRACT

DOUGLAS POINT, THE CANDU REACTOR.
C.E. BEYNDON

AECL-1807 /P. 25-30/ /1963/

THE WORLD'S REACTORS NO. 37 CANDU /DOUGLAS POINT/
NUCLEAR ENG. 9, 289-294 /+INSET/ /AUG. 1964/

DOUGLAS POINT, A PRE-CRITICAL REPORT.
CANADIAN NUCLEAR TECH. 5, 19-33 /SEPT-OCT, 1966/

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EF04

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NAME/OWNER	WR-1 /WHITESHELL REACTOR-1/AECL, CANADA OCDRE/OTR	
DESIGNER	CANADIAN GENERAL ELECTRIC CO.	
OPERATOR	AECL	
LOCATION	SEE REMARKS	
PURPOSE	SEE REMARKS	
TYPE	HEAVY WATER MODERATED, ORGANIC COOLED, PRESSURE TUBE /CALANDRIA/	
POWER MWE(MWT)	40-60	
CRITICAL	NOV, 1965	
COOLANT	TERPHENYL	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM CARBIDE	
FUEL GEOMETRY	ROD 96 IN. ACTIVE LENGTH	
FUEL CLADDING	SAP 0.0235 IN. THICK	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	19-ROD BUNDLE SS FUEL TUBES	
NEUTRON FLUX	THERMAL MAX. 1.08×10^{14}	
COOLANT TEMP.	INLET 640 F	OUTLET 700 F
COOLANT PRESS.		OUTLET 165 PSI
REACTOR VESSEL	VERTICAL CYLINDER SS. 8 FT. 10 IN. ID./16.5 FT. HIGH. CALANDRIA TUBES ALUMINUM ALLOY, SS FUEL CHANNELS.	
REMARKS	THE OCDRE PROJECT WAS DROPPED IN FAVOR OF AN ORGANIC TEST REACTOR, THE WR-1 CANADIAN GE HAS PROPOSED A DESIGN FOR THE HEAVY WATER MODERATED, ORGANIC COOLED PROTOTYPE FOR JEN -SPAIN- DON. THE 106.5 MWT REACTOR CONSISTS OF A CALANDRIA, 132 FUEL CHANNELS, CENTRAL TEST CHANNEL, SHUT-DOWN SHIELDS, AND A TOP ROTATING	

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EF04

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DECK PLATE.

REFERENCES

THE OGDRE PROGRAM.

WM CAMPBELL

AECL-945 /OCTOBER 1959/

THE ORGANIC-COOLED HEAVY-WATER MODERATED REACTOR
SYSTEM.

KH CAMPBELL

AECL-1807 /P. 68-73/ /1963/

WR-1 TYPE REACTOR PROPOSED FOR SPAIN-S DON
DBA CHASE P. ENG. /CAN. GENERAL ELECTRIC CO/
CANADIAN NUCLEAR TECHNOLOGY FALL 1965 P. 42-43

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF05

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NAME/OWNER	ESSOR /ESSAI ORGEL//EURATOM
DESIGNER	GAAA, INTERATOM, MONTECATINI
PURPOSE	TEST BED IN ORGEL PROJECT.
TYPE	HEAVY WATER MODERATED AND COOLED, PRESSURE TUBE
POWER MWE(MWT)	0 35
CRITICAL:	CONSTRUCTION
COOLANT	HEAVY WATER
MODERATOR	HEAVY WATER
FUEL MATERIAL	URANIUM ALLOY FEED FUEL. SEE REMARKS.
FUEL GEOMETRY	PLATES CURVED AND MOUNTED TO FORM 3-PART TUBULAR ELEMENT 150 CM. LONG.
FUEL CLADDING	ALUMINUM
FUEL ENRICH.	HIGH
FUEL ASSEMBLY	BR-2 TYPE ELEMENTS, 16 CHANNELS SURROUNDING THE EXPERIMENTAL OR ORGEL ZONE. 17-PLATE ELEMENTS IN 44 FUEL EMPLACEMENTS, 20 OF WHICH ARE SUPPLEMENTARY. THE CENTRAL OR ORGEL ZONE HAS 12 CHANNELS, EACH WITH INDEPENDENT COOLANT LOOP.
BURNUP(REFUEL)	4 ELEMENTS / MONTH
CONTROL	RODS
COOLANT TEMP.	INLET 47 C
REACTOR VESSEL	CENTRAL ZONE COMPARTMENT AN ALUMINUM VESSEL, VERTICAL SS TANK CONTAINING HEAVY WATER, WITH EXTENSIONS IN THE LOWER PART FOR PASSAGE OF THE ORGEL CHANNELS-ZIRCALOY CALANDRIA TUBES, SINTERED SAP PRESSURE TUBES, GAS INSULATED.
CONTAINMENT	CYLINDRICAL SHELL 45 M. DIA.
REMARKS	TEST REACTOR IN THE EURATOM ORGEL PROGRAM FOR TESTING COOLANT CHANNEL ASSEMBLY, PRESSURE TUBE, THERMAL INSULATION, CALANDRIA TUBE, CONNECTIONS, FUEL ELEMENTS. ECO /EXPERIENCE CRITIQUE ORGEL/ DESIGNED BY DUTCH NERATOOM IS UNDER CONSTRUCTION

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EF05

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AT ISPRA CENTER IN ITALY. ECO WILL USE U METAL
RODS IN ALUMINUM CANS, DIPHENYL COOLANT AND HEAVY
WATER MODERATOR.

REFERENCES

DESCRIPTION OF A SPECIFIC TEST REACTOR FOR
STUDYING THE ORGEL SYSTEM.
C CHASSIGNET, OTHERS
POWER REACTOR EXPERIMENTS, VOL. II, PP. 183-212
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1962

ESSOR. SPECIFIC TEST REACTOR FOR HEAVY WATER
REACTOR CONCEPTS DEVELOPED BY EURATOM.
JC LENY, OTHERS
THIRD U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, 1964
A/CONF. 28/P/78

THE ORGEL PROJECT
JC LENY, S ORLOWSKI
NUCLEAR ENG. 10. 96-100 /MARCH 1965/

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF06

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NAME/OWNER	ORGEL /ORGANIQUE EAU LOURDE//EURATOM	
DESIGNER	REF. DESIGN BELGONUCLEAIRE, INDATOM, SIEMENS /SEE ALSO ESSOR/	
PURPOSE	POWER	
TYPE	HEAVY WATER MOD. ORGANIC COOLED-PRESSURE TUBE /CALANDRIA/	
POWER MWE(MWT)	250	759
CRITICAL	DEVELOPMENT	
COOLANT	TERPHENYLS	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM CARBIDE	
FUEL GEOMETRY	PENCILS OR TUBULAR ELEMENTS, 2.34 CM. OD.	
FUEL CLADDING	SAP 0.13 CM. THICK	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	7-ROD BUNDLES 452 CHANNELS A VARIANT FUEL ELEMENT IS A BUNDLE OF 4 SAP-CLAD PINS. TUBULAR ELEMENTS ARE ALSO BEING STUDIED.	
SPECIFIC POWER	24 MW/T	
BURNUP(REFUEL)	8900 MWD/TON	
NEUTRON FLUX	THERMAL MAX. 6.9×10^{13}	
COOLANT TEMP.	INLET 265 C	OUTLET 400 C
COOLANT PRESS.	16 KG/SQ.CM.	
REACTOR VESSEL	VERTICAL CYLINDER-SS-CONTAINING COLD HEAVY WATER, ZIRCALOY CALANDRIA TUBES, SAP PRESSURE TUBES, GAS INSULATED. /VERTICAL CALANDRIA TUBES/	
REMARKS	ESSOR, THE HEAVY WATER REACTOR DESIGNED BY GAAA AND INTERATOM, IS AN EXPERIMENTAL REACTOR FOR ORGEL, EURATOM'S DEVELOPMENT OF THE ORGANIC REACTOR CONCEPT. ECO /EXPERIENCE CRITIQUE ORGEL/, DESIGNED BY DUTCH NERATOM, IS UNDER WAY AT ISPRA	

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF06

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CENTER IN ITALY. ECO WILL USE J METAL RODS IN AL
CANS, DIPHENYL COOLANT AND HEAVY WATER MODERATOR.
EXPO, THE EXPONENTIAL EXPERIMENT, IS ALSO UNDER
CONSTRUCTION AT ISPRA. TARGET FOR ESSOR IS 1965.
A PRELIMINARY STUDY HAS BEEN CARRIED OUT FOR A
CHEMICAL COMPLEX EQUIPPED WITH AN ORGEL REACTOR
FUELED WITH SLIGHTLY ALLOYED NATURAL URANIUM.
EURATOM HAS DECIDED TO ASK FOR A DETAILED DESIGN
STUDY FOR AN ORGEL PROTOTYPE.

REFERENCES

ORGEL-A EUROPEAN CONCEPT.
JC LENY
NUCLEAR ENG. 6. 508-12 /DECEMBER 1961/

DESIGN CRITERIA, ENGINEERING FEATURES,
EXPERIMENTAL PROGRAM FOR THE ECO REACTOR.
P BONNAURE, OTHERS
ENERGIA NUCLEARE 9 /9/, 529-34 /SEPTEMBER 1962/

EXPERIENCE CRITIQUE ORGEL /ECO/
NUCLEAR ENG. 8. 440-41 /DEC. 1963/

LE PROJET ORGEL
NEUE TECHNIK /NT/ NO. 10, 1963 P. 585-96

THE ORGEL PROJECT
JC LENY, S ORLOWSKI
NUCLEAR ENG. 10. 96-100 /MARCH 1965/

WHAT IS ORGEL - A BRIEF RECAP.
EURATOM 4. 49-54 /JUNE 1965/

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF07

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NAME/OWNER	VULCAIN / BELGONUCLEAIRE-UK AEA
DESIGNER	BELGONUCLEAIRE-UKAEA
LOCATION	SEE REMARKS
PURPOSE	SHIP PROPULSION
TYPE	PWR, SPECTRAL SHIFT
POWER MWE(MWT)	20 65 /FOR 20,000 SHP/
CRITICAL	CONSTRUCTION, DEVELOPMENT. SEE REMARKS
COOLANT	HEAVY WATER-LIGHT WATER.
MODERATOR	HEAVY WATER-LIGHT WATER.
FUEL MATERIAL	URANIUM DIOXIDE PELLETS, 7.5 MM. DIA.
FUEL GEOMETRY	PINS, 3 FT. 8 3/4 IN. ACTIVE LENGTH
FUEL CLADDING	SS
FUEL ENRICH.	6 PER CENT U-235
FUEL ASSEMBLY	181-PIN ASSEMBLY. HOLLOW INCOMPLETE HEXAGONAL, WITH CENTRAL ZIRCALOY TUBE AS GUIDE FOR SHUT-OFF ROD. NO SHROUDS. 18 ASSEMBLIES IN CORE
FUEL CHARGE	1283 KG. URANIUM
BURNUP(REFUEL)	40,000-45,000 MWD/T 3 YEARS
NEUTRON FLUX	THERMAL AVE. 3×10^{13} E+13
CONTROL	SPECTRAL SHIFT, BORON-SS RODS
COOLANT PRESS.	2100 PSI
REACTOR VESSEL	STEEL VESSEL 6 FT. 4 IN. ID., 153 IN. HIGH. POSSIBLY SS INNER CLADDING.
CONTAINMENT	STEEL SPHERE 25 FT. DIA., 1 1/8 IN. THICK. SECONDARY CONCRETE SHIELDING.
REMARKS	AN AGREEMENT FOR JOINT DEVELOPMENT OF THE CONCEPT BY BELGONUCLEAIRE AND THE UKAEA HAS BEEN SIGNED.

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EF07

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THE STUDY WILL ENTAIL AN ADVANCED PWR EMBODYING THE PRINCIPLE OF SPECTRAL SHIFT CONTROL. A CRITICAL ASSEMBLY VENUS HAS BEEN BUILT AT MOL. CORE TESTING IN THE BR-3 IS IN PROGRESS. AT THE END OF THIS PHASE THE UK-BELGIUM PHASE OF DEVELOPMENT WILL END. BELGIUM PLANS A FULL-SCALE LAND-BASED PROTOTYPE AS ITS NEXT STEP, WITH PLANT DESIGN POWER 16-20 MWT. POSSIBLE SITE IS AT THE UNIV. OF LIEGE IN SART TILMAN, WITH STEAM OUTPUT OF THE PLANT FOR USE IN HEATING THE UNIVERSITY BUILDINGS. DESIGN THERMAL OUTPUT WOULD BE 72 MW.

A VULCAIN SPECTRAL SHIFT CORE OPERATED IN THE BELGIAN BR-3 IN NOV. 1966.

REFERENCES

PROJECT VULCAIN, DESCRIPTION AND PRINCIPAL CHARACTERISTICS,
VN-61-305 /BELGONUCLEAIRE, 1961/

THE VULCAIN PROJECT AND ITS DEVELOPMENT PROCESSES,
P MALDAGUE
ATOMWIRTSCHAFT 7. 317-21 /JUNE 1962/

THE VULCAIN REACTOR,
PE MALDAGUE
POWER REACTOR EXPERIMENTS. VOL. 2, P. 253-73
INTERNATIONAL ATOMIC ENERGY AGENCY. VIENNA. 1962.

THE U. K. ATOMIC ENERGY AUTHORITY-S NUCLEAR SHIP CONCEPTS,
NUCLEAR ENG. 8, 88-9 /MARCH 1963/

THE VULCAIN CORE POWER EXPERIMENT,
J STORRER
GENEVA 1964. A/CONF.28/P/515

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF08

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NAME/OWNER	RAPP/RAJASTHAN ATOMIC POWER PROJECT//INDIA,
DESIGNER	CANADIAN GENERAL ELECTRIC
LOCATION	RANA PRATAP SAGAR, RAJASTHAN STATE, INDIA
PURPOSE	POWER
TYPE	HEAVY WATER MODERATED AND COOLED, PRESSURE TUBE /CALANDRIA/
POWER MWE(MWT)	200
CRITICAL	CONSTRUCTION. TARGET 1969
COOLANT	HEAVY WATER
MODERATOR	HEAVY WATER
FUEL MATERIAL	URANIUM DIOXIDE
FUEL GEOMETRY	RODS
FUEL ENRICH.	NATURAL
REMARKS	CANADA WILL SUPPLY HALF THE FUEL FOR THE FIRST CHARGE, STATION WILL CONSIST OF TWO 200 MWE PLANTS RAPP-1 AND RAPP-2.
REFERENCES	FOR GENERAL DESIGN PARAMETERS SEE CANDU

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EF09

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NAME/OWNER	KALPAKKAM STATION / INDIA
DESIGNER	JOHNSON GROUP, SWEDEN
LOCATION	KALPAKKAM, NEAR MADRAS, INDIA
PURPOSE	POWER
TYPE	HEAVY-WATER MODERATED AND COOLED PWR
CRITICAL	DESIGN AND DEVELOPMENT
COOLANT	HEAVY WATER
MODERATOR	HEAVY WATER
FUEL MATERIAL	URANIUM
FUEL ENRICH.	NATURAL
REMARKS	SWEDEN-S ATOMENERGI AB AND INDIA-S AEC WILL MAKE A COST STUDY FOR A NATURAL U, PRESSURIZED HEAVY WATER REACTOR TO BE LOCATED AT KALPAKKAM, NEAR MADRAS. SWEDEN-S JOHNSON INDUSTRIAL GROUP HAS DESIGNED THE REACTOR, BASED ON EXPERIENCE WITH THE AGESTA REACTOR NEAR STOCKHOLM.
REFERENCES	VJCLEONICS WEEK MARCH 5, 1964 P 3 NEWS RELEASE

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EF10

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NAME/OWNER	HALDEN REACTOR/JENER, NORWAY AND OEEC	
DESIGNER	JENER, NORWAY	
OPERATOR	EUROPEAN NUCLEAR ENERGY AGENCY	
LOCATION	HALDEN, NORWAY	
PURPOSE	PROCESS STEAM	
TYPE	HEAVY WATER MODERATED AND COOLED BWR	
POWER MWE(MWT)	0	20
CRITICAL	1959	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE, FIRST CORE URANIUM METAL WITH URANIUM DIOXIDE SPIKE ELEMENTS.	
FUEL GEOMETRY	RODS 25 MM. DIA./2.4 M. LONG	
FUEL CLADDING	SS. FIRST CORE FINNED ALUMINUM	
FUEL ENRICH.	SLIGHT, FIRST CORE NATURAL URANIUM.	
FUEL ASSEMBLY	316 RODS/CORE. PROVISION FOR 325	
NEUTRON FLUX	THERMAL PEAK 3×10^{13}	
CONTROL	SHIM AND SCRAM RODS, CADMIUM TUBES, SS CLAD	
COOLANT PRESS.	400 PSI	
REACTOR VESSEL	CLAD STEEL CYLINDER 2.7 M. DIA./476 CM. HIGH.	
CONTAINMENT	FACILITY IS CONSTRUCTED IN A CAVE WITH THE REACTOR IN A DEEP PIT IN THE FOUNDATION. REACTOR HALL IS 28 M./10 M./11.4 M. HIGH.	
REMARKS	SECOND CORE OPERATION MARCH 1962. PROPOSED CONVERSION TO SPECTRAL SHIFT CONTROL, INTEREST IS IN APPLICATION TO AN OCEANOGRAPHIC RESEARCH VESSEL. A 3-YEAR RESEARCH PROGRAM WILL BE DEVOTED TO LONG-TERM TESTING OF FUEL ELEMENTS, EXPERIMENTAL CHEMISTRY, DEVELOPMENT OF INSTRUMENTATION, PARTICIPANTS WILL INCLUDE	

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UK AEA, NORWEGIAN INST. FOR ATOMENERGI, DANISH AND
FINNISH AEC, RCN /NETHERLANDS/, AB-ATOMENERGI
/SWEDEN/, AND US AEC. FULL DESIGN OUTPUT OF
20 MWT /ON SECOND FUEL CHARGE/ HAS BEEN USED TO
PROVIDE PROCESS STEAM FOR NEARBY PAPER AND PULP
MILLS /JANUARY 1964/
THE DEVELOPMENT PROGRAM HAS BEEN EXTENDED TO
DECEMBER 1969 AND WILL INCLUDE ON-LINE COMPUTER
CONTROL OF THE REACTOR, AND THORIUM PHYSICS
INVESTIGATIONS.

REFERENCES

THE HALDEN BOILING WATER REACTOR,
N HIDDLE, O DAHL
HPR-2 /1958/

HALDEN BWR
NUCLEAR ENG, 4. 106-12 /MARCH 1959/

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF11

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NAME/OWNER KANUPP/KARACHI NUCLEAR POWER PROJECT/ PAKISTAN

DESIGNER CANADIAN GENERAL ELECTRIC

LOCATION KARACHI AREA, PAKISTAN /PARADISE POINT/

PURPOSE POWER

TYPE HEAVY WATER MODERATED AND COOLED.
HORIZONTAL PRESSURE TUBE, INTEGRAL DESIGN

POWER MWE(MWT) 132

CRITICAL TARGET 1968

COOLANT HEAVY WATER

MODERATOR HEAVY WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL GEOMETRY RODS

FUEL CLADDING ZIRCONIUM ALLOY-THIN WALL

FUEL ENRICH. NATURAL

FUEL ASSEMBLY 19-ELEMENT BUNDLE
2288 FUEL BUNDLES/CORE
11 BUNDLES/FUEL CHANNEL

BURNUP(REFUEL) ON-LOAD

REACTOR VESSEL INTEGRAL CALANDRIA/DUMP-TANK SURROUNDED BY A LIGHT
WATER THERMAL SHIELD. CALANDRIA IS SS 16 FT. 6 IN.
BY 16 FT. 4 IN. FUEL CHANNELS ARE ZIRCONIUM ALLOY.REMARKS CANADIAN CONSTRUCTION OF THE NUCLEAR POWER PLANT
FOR THE KARACHI AREA HAS BEEN APPROVED. THE
REACTOR WILL BE SUPPLIED BY CANADIAN GE. ON-LINE
TARGET IS 1968.
UNITIZED SYSTEM COMBINES THE CALANDRIA AND DUMP
TANK INTO A SINGLE UNIT. THE LIGHT WATER THERMAL
SHIELD SURROUNDS THE CALANDRIA/DUMP TANK ASSEMBLY.
THE INTEGRATED ASSEMBLY IS SS, WITH 208 FUEL SITES
EACH ACCOMMODATING 11 FUEL BUNDLES. FUEL CHANNELS
ARE ZIRCONIUM ALLOY CALANDRIA TUBES, 4 IN. ID.,
WITH INNER 3 1/4 IN. ID. COOLANT TUBES.

REFERENCES PAKISTAN TURNKEY CONTRACT FOR CGE

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CANADIAN NUCLEAR TECHNOLOGY 4, 23-24 /SUMMER 1965/

KANUPP DESIGN DETAILS

CANADIAN NUCLEAR TECHNOLOGY 4, 24 /SUMMER 1965/

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF12

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NAME/OWNER	DON / JEN, CENUSA-SPAIN	
DESIGNER	AI /UNITED STATES/-JEN	
OPERATOR	CENTRALES NUCLEARES SA /CENUSA/	
PURPOSE	POWER PROTOTYPE	
TYPE	HEAVY WATER MODERATED, ORGANIC COOLED, CALANDRIA,	
POWER MWE(MWT)	30	106,5
CRITICAL	DESIGN AND DEVELOPMENT	
COOLANT	SANTOWAX OMP	
MODERATOR	HEAVY WATER, HEAVY WATER REFLECTOR	
FUEL MATERIAL	URANIUM CARBIDE PELLETT 12,7 MM, DIA.	
FUEL GEOMETRY	ROD, 2895,6 MM, ACTIVE LENGTH	
FUEL CLADDING	SAP 0,5 MM, THICK, FINNED	
FUEL ENRICH.	1,7 PER CENT U-235	
FUEL ASSEMBLY	19-ROD CLUSTER, SAP SHROUD TUBE. 138 ELEMENTS/CORE	
FUEL CHARGE	12230 KG, URANIUM	
SPECIFIC POWER	8,2 KW/KG U	
BURNUP(REFUEL)	8000 MWD/MTU	
CONTROL	RODS, STEEL TUBES FILLED WITH BORON CARBIDE	
COOLANT TEMP.	INLET 299 C	OUTLET 343 C
REACTOR VESSEL	ALUMINUM CALANDRIA STRUCTURE FOR THE HEAVY WATER. PROCESS TUBES ARE SAP IN CORE REGION, SS AND CARBON STEEL IN THE REST.	
CONTAINMENT	CONVENTIONAL BUILDING, LEAK TIGHT.	
REMARKS	CONCEPTUAL DESIGN BY AI HAS BEEN COMPLETED, FINAL PLANS WILL BE DEVELOPED BY JEN. CONSTRUCTION TARGET WAS 1965-NO CURRENT INFORMATION,	
REFERENCES	ORGANIC COOLED HEAVY WATER MODERATED POWER REACTOR	

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STUDY.

BL HOFFMAN

TID-7575 /P, 108/ /MARCH 1959/

THE 22ND PROJECT.

L PALACOIS, G VELARDE /JEN, MADRID/

PREPRINT /OTTOWA/

CANADIAN NUCLEAR ASSOC., 1962

THE DON PROJECT.

F PASCUAL, L PALACOIS, MK SANDERS

THIRD U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964, A/CONF, 28/P/601

SAFETY FEATURES OF THE DON REACTOR CONCEPT,

A ALONSO, BL HOFFMAN.

THIRD U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964, A/CONF, 28/P/495

DEVELOPMENT OF THE DON PROJECT

EURONUCLEAR 2, 283-4 /JUNE 1965/

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF13

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NAME/OWNER	AGESTA REACTOR STATION/STATE POWER, AB-ATOMENERGI, CITY OF STOCKHOLM, SWEDEN	
DESIGNER	ASEA-AB ATOMENERGI R/3-ADAM	
OPERATOR	STATE POWER BOARD, SWEDEN	
LOCATION	AGESTA, SWEDEN	
PURPOSE	POWER AND DISTRICT HEATING	
TYPE	HEAVY WATER MODERATED AND COOLED PWR	
POWER MWE(MWT)	10	65
CRITICAL	JULY 1963, FULL POWER MARCH 1964	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 17 MM, DIA./733 MM, LONG	
FUEL GEOMETRY	ROD COMPOSED OF 3 ELEMENTS SCREWED TOGETHER, 3 M, LONG	
FUEL CLADDING	ZIRCALOY-2 TUBE	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	19-ROD BUNDLE, 4 BUNDLES MAKE UP THE FUEL ELEMENT, IN ZIRCALOY PROTECTIVE CAN, 140 ELEMENTS/CORE	
FUEL CHARGE	18 TON URANIUM DIOXIDE	
BURNUP(REFUEL)	5000 MWD/T	
CONTROL	RODS, HYDRAULIC OPERATION, SILVER-INDIUM-CADMIUM IN SS CLADDING	
COOLANT TEMP.	INLET 400 F	OUTLET 430 F
COOLANT PRESS.	495 PSIG	
REACTOR VESSEL	STEEL VESSEL, INNER SS CLADDING, 4.5 M, DIA, AND 6 M, HIGH	
CONTAINMENT	CAVERN, LINED WITH CONCRETE AND WELDED STEEL PLATE	

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REMARKS

THE PROJECT DEVELOPED FROM TWO DESIGN STUDIES, DESIGNATED R-3 AND ADAM. IN THE ADAM CONCEPT DEVELOPED BY ASEA FOR HOUSE HEATING PURPOSES, PRESSURE VESSEL WAS FILLED WITH HEAVY WATER, COOLANT ENTERED THE REACTOR VESSEL BY 8 PIPES THROUGH THE BOTTOM, FLOWED UPWARD THROUGH THE MODERATOR, AND WAS TURNED DOWNWARD BETWEEN THE THERMAL SHIELD AND THE VESSEL WALL. IT WAS THEN DISTRIBUTED TO THE FUEL ELEMENTS THROUGH A SPACE BETWEEN THE GRID PLATE AND THE BOTTOM ALUMINUM CASTING. AFTER PASSING THE FUEL RODS THE HEAVY WATER ENTERED THE UPPER PLENUM AND LEFT THE REACTOR. A FUEL ELEMENT WAS COMPOSED OF 19 ALUMINUM CANS CONTAINING FUEL PELLETS. THERE WERE 168 ELEMENTS IN THE CORE. IN THE R-3 CONCEPT DEVELOPED BY AB-ATOMENERGI FOR POWER AND HEAT PRODUCTION, THE FUEL ELEMENT CONTAINED FIVE SUBASSEMBLIES OR BUNDLES COMPOSED OF 19 INDIVIDUAL FUEL RODS IN A SUPPORTIVE SHROUD OF ZIRCALOY-2. EACH FUEL ROD WAS BUILT UP OF URANIUM DIOXIDE PELLETS ENCASED IN A ZIRCALOY-2 CAN. COOLANT FLOW WAS UPWARD THROUGH THE FUEL ELEMENT SHROUDS, THEN DOWNWARD THROUGH THE MODERATOR AND BOTTOM REFLECTOR REGIONS TO THE OUTLET NOZZLES. THE AGESTA PWR HAS A CYLINDRICAL CORE CONTAINING 140 ELEMENTS SECURED TO THE LID OF REACTOR PRESSURE VESSEL. ELEMENTS PENETRATE BOTTOM CORE PLATE INTO COOLANT PLENUM. COOLANT FLOW IS FROM THE INLET PLENUM UPWARD THROUGH ELEMENTS, DOWNWARD IN THE MODERATOR SPACE BETWEEN THE ELEMENTS. THERE IS A PROVISION FOR RAISING THE REACTOR OUTPUT TO 125 MWT BY MEANS OF A MORE POWERFUL CORE AND ADDED HEAT EXCHANGERS /STAGE II/.

REFERENCES

R/3-ADAM. SWEDISH NUCLEAR HEAT-ELECTRIC STATION, NUCLEAR ENG. 5, 202-5 /MAY 1960/

DESCRIPTION OF THE AGESTA PLANT.
/BOOK IN PREPARATION. NEW TECHNIQUE /NT/ 12.713,
1963/

THE AGESTA REACTOR,
B MC HUGH
NUCLEAR ENERGY SEPT, 1964 P. 252-261

THE SWEDISH AGESTA POWER REACTOR
FA ABADIE-MAUMERT
ENERGIE NUCLEAIRE 7, 330-32 /SEPT.-OCT, 1965/

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HEAVY WATER MODERATED REACTORS. FOREIGN

EF14

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NAME/OWNER	MARVIKEN POWER STATION/STATE POWER BOARD, SWEDEN
DESIGNER	AB-ATOMENERGI, SWEDEN
OPERATOR	STATE POWER BOARD, SWEDEN
LOCATION	MARVIKEN, SWEDEN /NORKOPINGS BAY AREA/
PURPOSE	POWER AND SPACE HEAT
TYPE	HEAVY WATER MODERATED AND COOLED BWR, DIRECT CYCLE, NATURAL CIRCULATION, INTEGRAL NUCLEAR SUPERHEAT
POWER MWE(MWT)	200 WITH INTEGRAL SUPERHEAT
CRITICAL	CONSTRUCTION TARGET 1968
COOLANT	HEAVY WATER
MODERATOR	HEAVY WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 12.5 MM. DIA. /BOILING/ AND 11.5 MM. DIA. /SUPERHEATING/
FUEL GEOMETRY	ROD
FUEL CLADDING	BOILER ZIRCALOY-2 SUPERHEATER CHROMIUM-NICKEL STEEL
FUEL ENRICH.	BOILER 1.3 PER CENT U-235 SUPERHEATER 1.5 PERCENT
FUEL ASSEMBLY	31-ROD CLUSTERS IN BOILING REGION. 48-ROD CLUSTERS IN SUPERHEATING REGION. 147 BOILING CHANNELS 32 SUPERHEATING CHANNELS
SPECIFIC POWER	18 KW/KG URANIUM
BURNUP(REFUEL)	13000 MWD/T FUEL SHUFFLING
CONTROL	RODS
REACTOR VESSEL	STEEL VESSEL, SS LINED, 5.22 M. ID.
CONTAINMENT	CONVENTIONAL STRUCTURE, PRESSURE-SUPPRESSION.
REMARKS	A REDESIGN OF THE ORIGINAL PROPOSAL WAS DONE

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UNDER PROJECT BASHFUL, WHICH WAS CONCERNED WITH A NATURAL CIRCULATION DIRECT CYCLE PLANT. THE ORIGINAL PROPOSAL WAS FOR A 100 MWE BWR. ADVANCED DESIGN ENVISAGES THE GENERATION OF SUPERHEATED STEAM TO PRODUCE 204 MWE, BUT IT COULD PRODUCE 160 MWE OPERATING WITH SATURATED STEAM. PLUTONIUM FUELS WILL BE STUDIED. THE PROJECT HAS BEEN RENAMED MARVIKEN-K. SWEDISH PARLIAMENT HAS APPROVED CONSTRUCTION OF A 200 MWE STATION. PRELIMINARY WORK IS REPORTEDLY IN PROGRESS ON AN ENLARGED REACTOR, BASHFUL-1000 OF THE MARVIKEN TYPE.

REFERENCES

BF-4. SUMMARY REPORT /PRE-PROJECT/ CONCERNING BASHFUL AB, ATOMENERGI REPORT, MAY 1962
NEUE TECH. /NT/ 4/12/. 713 /1963/

THE DEVELOPMENT WORK LEADING UP TO THE MARVIKEN NUCLEAR POWER STATION.

PH MARGEN

NEUE TECH. /NT/ 4/12/. 699-714 /1963/

HEAVY WATER STEAM IN DIRECT CYCLE-MARVIKEN

R NILSEN

NUCLEAR ENG. 11, 456-60 /JUNE 1966/

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HEAVY WATER MODERATED REACTORS. FOREIGN

EF15

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NAME/OWNER	PHWR /PRESSURIZED HEAVY WATER REACTOR/ AB-ATOMENERGI, SWEDEN	
DESIGNER	AB-ATOMENERGIE, SWEDISH JOHNSON CO.	
PURPOSE	POWER REACTOR STUDY.	
TYPE	HEAVY WATER MODERATED AND COOLED, CROSS-FLOW	
POWER MWE(MWT)	250-400	1200
CRITICAL	CONCEPT	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM /LATER PLUTONIUM-ENRICHED URANIUM/	
FUEL GEOMETRY	ROD	
FUEL CLADDING	ZIRCONIUM	
FUEL ENRICH.	1.5 PER CENT U-235	
FUEL ASSEMBLY	SINGLE ELEMENT - NO CLUSTERING	
FUEL CHARGE	APPROX, 33.7 TONS URANIUM	
SPECIFIC POWER	35.6 KG/KG U	
REACTOR VESSEL	CYLINDRICAL, 36 M. DIA./50 M. HIGH	
REMARKS	<p>CONCEPT IS BASED ON A CROSS-FLOW REGIME, WITH THE FUEL ELEMENTS LAID ACROSS THE PATH OF THE COOLANT FLOW, PROVIDING DIRECT CONTACT BETWEEN FUEL AND HEAVY WATER. PHWR-400 IS AN INVESTIGATION OF CONCEPT AS A POSSIBLE CHOICE FOR FULL-SCALE INSTALLATION FOR 1970 SERVICE. FULL-SCALE REACTOR EVALUATION HAS BEEN DONE BY NORDSTJERNAN GROUP IN COLLABORATION WITH AB ATOMENERGIE AND US WESTINGHOUSE. A FINAL REPORT ON THE FEASIBILITY OF A 250 MW PLANT HAS BEEN COMPLETED FOR AB ATOMENERGIE BY WESTINGHOUSE, BECHTEL, JOHNSON CO. THE FEASIBILITY OF BUILDING A PHWR IN MADRAS STATE, INDIA, IS BEING STUDIED BY JOHNSON CO. AND INDIA-S AEC.</p>	
REFERENCES	APPLIED ATOMICS, MAY 16, 1962, P. 11-12.	

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HEAVY WATER MODERATED REACTORS. FOREIGN

EF16

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NAME/OWNER	SULZER PROJECT/FEDERAL INST. TECH., SWITZERLAND
DESIGNER	SULZER BROTHERS, SWITZERLAND
OPERATOR	FEDERAL INSTITUTE OF TECHNOLOGY, SWITZERLAND
LOCATION	ZURICH, SWITZERLAND
PURPOSE	POWER AND DISTRICT HEAT
TYPE	HEAVY WATER MODERATED AND COOLED, PRESSURE TUBE
POWER MWE(MWT)	6-8 30
CRITICAL	CONSTRUCTION
COOLANT	HEAVY WATER
MODERATOR	HEAVY WATER, GRAPHITE REFLECTOR
FUEL MATERIAL	URANIUM METAL
FUEL GEOMETRY	HOLLOW RODS
FUEL CLADDING	ZIRCALOY
FUEL ENRICH.	NATURAL /OUTER ANNULAR RING 1 PER CENT U-235/
FUEL ASSEMBLY	INDIVIDUAL FUEL TUBE IS BONDED ON THE INSIDE TO A ZIRCALOY PRESSURE TUBE, 13 MM. ID. EIGHT TUBE ELEMENTS, WITH AN OUTER THIN ZIRCALOY SHEATH, ARE HOUSED IN AN OUTER CASING TUBE, SEPARATED FROM THE HOT URANIUM SURFACE BY INSULATION. 88 ELEMENTS/CORE
CONTROL	RODS
REACTOR VESSEL	MODERATOR TANK, THIN-WALLED ALUMINUM, OPEN AT TOP GRAPHITE REFLECTOR BELOW AND AT SIDES, THERMAL SHIELDS, AND CYLINDRICAL BIOLOGICAL SHIELD OF CONCRETE WHICH CAN SERVE AS PRESSURE VESSEL. THERMAL SHIELD IS WATER-COOLED.
CONTAINMENT	UNDERGROUND CONSTRUCTION.
REFERENCES	SULZER PROJECT FOR A PROTOTYPE HEAVY WATER POWER REACTOR FOR LOCATION IN AN UNDERGROUND CAVERN, P DE HALLER, AF FRITZSCHE SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY 9, 16-35 /1958/

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REPORT ON THE CONSTRUCTION OF A NUCLEAR HEAT AND
POWER STATION FOR THE DISTRICT HEATING STATION
OF THE FEDERAL INSTITUTE OF TECHNOLOGY.
SULZER BROS.
NP-7945 /N.D./

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF17

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 NAME/OWNER EXPERIMENTAL POWER PLANT LUCENS/SNA, SWITZERLAND
 DESIGNER SULZER BROTHERS, SWITZERLAND
 OPERATOR SNA, SWITZERLAND
 LOCATION LUCENS, SWITZERLAND
 PURPOSE POWER EXPERIMENT
 TYPE HEAVY WATER MODERATED AND COOLED, PRESSURE TUBES
 /CALANDRIA/
 POWER MWE(MWT) 6-7 30
 CRITICAL TARGET 1966
 COOLANT HEAVY WATER
 MODERATOR HEAVY WATER
 FUEL MATERIAL URANIUM-CHROMIUM ALLOY
 FUEL GEOMETRY ROD, 17 MM, DIA./650 MM, LONG. 4 SEGMENTS/ROD
 FUEL CLADDING MAGNESIUM-ZIRCONIUM ALLOY, FINNED, 1.75 MM, THICK
 FUEL ENRICH. 0.96 PER CENT U-235
 FUEL ASSEMBLY 7-ROD ELEMENT /GRAPHITE SUPPORT IN THE PRESSURE
 TUBE, INTO WHICH RODS ARE INSERTED/
 CORE IS CYLINDRICAL WITH 2 CONCENTRIC ZONES.
 73 ELEMENTS
 FUEL CHARGE 5640 KG, URANIUM
 SPECIFIC POWER 12 KW/KG U
 CONTROL RODS, TUBULAR, SILVER-CADMIUM ALLOY CLAD WITH SS,
 GAS-COOLED
 COOLANT TEMP. INLET 221 C OUTLET 384 C
 COOLANT PRESS. 60 ATM,
 REACTOR VESSEL MODERATOR VESSEL ALUMINUM CYLINDER, ZIRCALOY
 PRESSURE TUBES
 CONTAINMENT CAVERN CONSTRUCTION, BIOLOGICAL SHIELD,
 REMARKS SNA IS SPONSORING THE PROJECT, WHICH HAS REPLACED

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HEAVY WATER MODERATED REACTORS. FOREIGN

EF17

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THE PROPOSAL CONSIDERED BY SNA MEMBERS THERMATOM, ENUSA AND SUISTATOM FOR A REACTOR OF SULZER DESIGN. THE CORE IS DIVIDED INTO TWO AREAS BY THE PITCH OF THE FUEL ELEMENTS. THE PRESSURE TUBES ARE OF ZIRCALOY-2. COOLANT FLOWS DOWN THE INSIDE OF THE TUBE AND PASSES UP OVER THE FUEL ELEMENT PROPER.

REFERENCES

LUCENS, SWITZERLAND-S EXPERIMENTAL PRESSURE TUBE REACTOR,
NUCLEAR ENG, 7, 449-51 /NOVEMBER 1962/

THE EXPERIMENTAL NUCLEAR PLANT AT LUCENS.
P DE HALLER, W HELBLING
ENERGIE NUCLEAIRE 5, 501-11 /NOV. 1963/

THE NUCLEAR EXPERIMENTAL STATION AT LUCENS.
P VERSTRAETE
INDUSTRIES ATOMIQUES 3/4 , 55-67 /1964/

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF18

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NAME/OWNER	SGHWR /STEAM GENERATING HWR/AEA, UNITED KINGDOM	
DESIGNER	U.K. ATOMIC ENERGY AUTHORITY	
OPERATOR	U.K. ATOMIC ENERGY AUTHORITY	
LOCATION	WINFRITH HEATH, DORSET, ENGLAND	
PURPOSE	POWER PROTOTYPE	
TYPE	HEAVY WATER MODERATED, LIGHT WATER COOLED, PRESSURE TUBE /CALANDRIA/	
POWER MWE(MWT)	93	294
CRITICAL	PROTOTYPE CONSTRUCTION, TARGET 1967	
COOLANT	LIGHT WATER, BOILING	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS, BOILING REGION SOLID 0.57 IN. DIA, SUPERHEATING REGION HOLLOW 0.57 IN. OD./1.16 ID.	
FUEL GEOMETRY	BOILING REGION RODS SUPERHEAT REGION TUBES, ACTIVE LENGTH 144 IN.	
FUEL CLADDING	BOILING REGION ZIRCALOY-2 0.026 IN. THICK SUPERHEAT REGION SS 0.011 IN. THICK	
FUEL ENRICH.	1.4 PER CENT U-235	
FUEL ASSEMBLY	BOILING REGION 36-ROD CLUSTER, FULL CHANNEL LENGTH SUPERHEAT REGION 23-ROD CLUSTER /PERIPHERAL/ 104 BOILING CHANNELS 8 SUPERHEAT CHANNELS	
FUEL CHARGE	23.3 TONS FUEL	
BURNUP(REFUEL)	18000 MWD/T	ON-LOAD
CONTROL	VARYING THE MODERATOR LEVEL, NEUTRON ABSORBER CONCENTRATION IN THE MODERATOR, LIQUID SHUT-OFF RODS.	
COOLANT TEMP.	INLET 280 C	OUTLET 283 C /504 C SUPERHEAT/
COOLANT PRESS.	INLET /BOILING/ 990 PSIG AND /SUPERHEAT/ 920 PSIG	

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HEAVY WATER MODERATED REACTORS. FOREIGN

EF18

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REACTOR VESSEL ALUMINUM-MAGNESIUM ALLOY MODERATOR TANK MOUNTED
INSIDE WATER-FILLED SHIELD TANKS. ALUMINUM-
MAGNESIUM CALANDRIA TUBES, ZIRCALOY IN-CORE
PRESSURE TUBES.

CONTAINMENT CONCRETE VAULT, STEEL

REMARKS PROTOTYPE CONSTRUCTION WAS STARTED IN MAY, 1963.
THE UK HAS BEEN STUDYING THIS REACTOR CONCEPT
SINCE 1958. BRITAIN-S INDUSTRIAL CONSORTIA WILL
COLLABORATE AND SHARE IN DESIGN AND DEVELOPMENT
OF THE PROJECT. TECHNICAL COLLABORATION WILL ALSO
BE CARRIED ON WITH CANADA AND SWEDEN.

REFERENCES SYMPOSIUM ON PRESSURE TUBE WATER REACTORS.
BRITISH NUCLEAR ENERGY SOCIETY, RISLEY, LANCS.,
ENGLAND. JULY 1962.

THE SGHWR PROTOTYPE REACTOR.
A FIRTH, JER HOLMES
NUCLEAR ENG. 9,46-9 /FEB, 1964/

GENERAL DESIGN OF THE STEAM GENERATING HEAVY WATER
REACTOR.
S FAWCETT, OTHERS
THIRD U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964. A/CONF.28/P/129

THE STEAM GENERATING HEAVY WATER REACTOR
H CARTWRIGHT
TRG REPORT 1246 R /1966/

SGHWR. A DARK HORSE COMPETITOR
H CARTWRIGHT
NUCLEONICS 24, 60-63 /SEPT. 1966/

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HEAVY WATER MODERATED REACTORS. FOREIGN

EF19

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NAME/OWNER R-1 AND R-2 / USSR

DESIGNER USSR

PURPOSE POWER CONVERTER-CONCEPT DEVELOPMENT

TYPE HEAVY WATER MODERATED, ORGANIC COOLED, PRESSURE
TUBE.

POWER MWE(MWT) 500 1600

CRITICAL CONCEPTUAL DESIGNS R-1 AND R-2

COOLANT ORGANIC LIQUID

MODERATOR HEAVY WATER=GRAPHITE REFLECTOR.

FUEL MATERIAL R-1 NATURAL URANIUM METAL
R-2 URANIUM DIOXIDEFUEL GEOMETRY R-1 RODS
R-2 TUBES

FUEL CLADDING MAGNESIUM-BERYLLIUM ALLOY

FUEL ENRICH. NATURAL

FUEL ASSEMBLY R-1 THICK-WALLED ANNULAR URANIUM.
680 CENTRAL CHANNELS
356 PERIPHERAL CHANNELS
R-2 TUBULAR CLUSTERS
580 CENTRAL CHANNELS
290 PERIPHERAL CHANNELSFUEL CHARGE R-1 100 TONS URANIUM
R-2 120 TONS

BURNUP(REFUEL) R-2 9000 MWD/T

COOLANT TEMP. INLET 230 C OUTLET 300 C

REMARKS THE R-1 DESIGN HAS A HIGH PLUTONIUM PRODUCTION
RATE, AND R-2 A HIGH URANIUM FUEL BURNUP.
MATERIAL FOR THE PRESSURE TUBES IS NOT SPECIFIED.REFERENCES NATURAL URANIUM HEAVY-WATER-MODERATED ORGANIC-
COOLED POWER CONVERTER REACTOR.
A ALICHANOV, OTHERS
THIRD U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, MAY 1964, A/CONF.28/P/877

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF20

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NAME/OWNER	MZFR/MEHR-ZWECK-FORSCHUNGS REAKTOR//MINISTRY ATOMIC POWER, W. GERMANY	
DESIGNER	SIEMENS, W. GERMANY	
OPERATOR	GESELLSCHAFT FUR KERNFORSCHUNG MBH SOCIETY FOR NUCLEAR RESEARCH	
LOCATION	KARLSRUHE RESEARCH CENTER, KARLSRUHE, W. GERMANY	
PURPOSE	POWER PROTOTYPE	
TYPE	HEAVY WATER MODERATED AND COOLED, PRESSURE TUBE	
POWER MWE(MWT)	50	200
CRITICAL	OPERATION FEB, 1966	
COOLANT	HEAVY WATER	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 1.04 MM. DIA.	
FUEL GEOMETRY	ROD 1.864 MM. ACTIVE LENGTH	
FUEL CLADDING	ZIRCALOY-2 0.6 MM. THICK TUBE THICKNESS	
FUEL ENRICH.	NATURAL	
FUEL ASSEMBLY	37-ROD BUNDLE TWO ELEMENTS STACKED IN FUEL CHANNEL 242 ELEMENTS/CORE	
FUEL CHARGE	13570 KG, URANIUM DIOXIDE	
BURNUP(REFUEL)	ON-LOAD	
NEUTRON FLUX	THERMAL AVE. 1.2×10^{14}	
CONTROL	ABSORBER RODS, CADMIUM-INDIUM-SILVER, PLUS VARIATION IN THE MODERATOR TEMPERATURE	
COOLANT TEMP.	INLET 252 C	OUTLET 280 C
COOLANT PRESS.	1315 PSI	
REACTOR VESSEL	CYLINDER 13.45 FT. ID., CONTAINING A SECOND SUSPENDED VESSEL HOLDING THE MODERATOR. VESSEL IS	

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EF20

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PERFORATED BY SHROUD TUBES INSULATED BY LAYERS OF
STAGNANT WATER,

CONTAINMENT

SPHERICAL STEEL BUILDING 98.4 FT. DIA., 23 FT.
ABOVE GROUND,

REMARKS

RESEARCH AIMS ARE TO TEST NATURAL URANIUM
REACTOR FUEL ELEMENTS UNDER OPERATING CONDITIONS,
IN-PILE LOOP RESEARCH ON COOLANTS, MATERIALS
TESTING, THORIUM, U-233 FUEL CYCLE, ISOTOPE
PRODUCTION, PRODUCTION OF FISSILE MATERIAL,
NUCLEAR SUPERHEAT, NEW CONSTRUCTION DESIGNS, MZFR
IS A MODIFICATION OF THE SIEMENS SNDR-16/SIEMENS
NATURAL DEUTERIUM REACTOR/

REFERENCES

THE SIEMENS MULTIPURPOSE REACTOR DESIGN,
A ZEIGLER
NUCLEAR POWER 6, 71-4 /MARCH 1961/

APPLIED ATOMICS FEB. 16, 1966 P. 11
NEWS RELEASE

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF21

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NAME/OWNER MITSUBISHI HEAVY WATER REACTOR/MITSUBISHI ATOMIC
 POWER IND. INC., JAPAN

DESIGNER MITSUBISHI ATOMIC POWER IND. INC., JAPAN

PURPOSE POWER

TYPE HEAVY WATER MODERATED/COOLED, PWR, PRESSURE TUBE,
 CLOSED CYCLE

POWER MWE(MWT) 345 1163

COOLANT HEAVY WATER

MODERATOR HEAVY WATER
 REFLECTOR, LIGHT AND HEAVY WATER

FUEL GEOMETRY RODS

FUEL CLADDING ZIRCALOY TUBES

FUEL ENRICH. NATURAL PLUS DEPLETED URANIUM

FUEL ASSEMBLY 47,500 RODS/CORE
 500 LONGITUDINAL PRESSURE TUBES, COLD

BURNUP(REFUEL) 8000 MWD/TU

NEUTRON FLUX THERMAL AVE, 1.2×10^4

CONTROL RODS, MODERATOR POISON

COOLANT PRESS. 102 ATM.

REFERENCES DESIGN STUDY OF PRESSURIZE HEAVY WATER COOLED
 POWER REACTOR,
 MASA-TOSHI YOKOSUKA /MITSUBISHI AT. POWER IND./
 GENSHIRYOKU HATSUDEN 8, 51-61 /SEPT. 1964/

JANUARY 1967

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HEAVY WATER MODERATED REACTORS. FOREIGN

EF22

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NAME/OWNER YUGOSLAV REACTOR

DESIGNER UNO /YUGOSLAVIA/ AND ASEA /SWEDEN/

PURPOSE POWER

TYPE HEAVY WATER MOD. AND COOLED, BWR

POWER MWE(MWT) 200-400

CRITICAL DEVELOPMENT, TARGET 1971-72

COOLANT HEAVY WATER

MODERATOR HEAVY WATER

REMARKS AN AGREEMENT BETWEEN ASEA AND UNO ON REACTOR
DEVELOPMENT HAS BEEN SIGNED.REFERENCES BUSINESS ATOMICS REPORT MARCH 16, 1966 P. 4
NEWS RELEASE

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HEAVY WATER MODERATED REACTORS, FOREIGN

EF23

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NAME/OWNER	VENTURE/CANADIAN GENERAL ELECTRIC
DESIGNER	CANADIAN GENERAL ELECTRIC CO., LTD., CANADA
TYPE	HEAVY WATER MODERATED/COOLED VERTICAL PRESSURE TUBE
CRITICAL	DESIGN
COOLANT	HEAVY WATER
MODERATOR	HEAVY WATER
FUEL MATERIAL	URANIUM
FUEL ENRICH,	NATURAL
BURNUP(REFUEL)	ON-LOAD, SINGLE FACE
REACTOR VESSEL	CALANDRIA, ZIRCONIUM ALLOY PRESSURE TUBES
REFERENCES	NUCLEAR CANADA JUNE 1966 P, 2 NEWS RELEASE

FD

LIQUID METAL COOLED REACTORS

DOMESTIC

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LIQUID METAL REACTORS, DOMESTIC

FD01

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NAME/OWNER U.S. AEC FAST REACTOR PROGRAM

TYPE LIQUID METAL COOLED FAST BREEDER

POWER MWE(MWT) 1000

CRITICAL AEC PROGRAM

COOLANT SODIUM

REMARKS PLANS INCLUDE FOUR STAGES,
 1969, DECISION ON FAST REACTOR TECHNOLOGY
 1973, PROTOTYPE OPERATION, 200 MWE
 1980, IMPROVED DEMONSTRATION PLANTS, 400-800
 MWE
 1989, COMMERCIAL PLANT OPERATION, 1000 MWE
 FIVE FACILITIES WILL PROVIDE PHYSICS DATA FOR
 PROTOTYPE PLANT DESIGN,
 ZPR-III, IDAHO
 ZPR-IV, ARGONNE
 FARET
 ZPPR
 SEFOR
 THE PLANT WILL BE SODIUM COOLED, WITH URANIUM
 PLUTONIUM /METAL OR CERAMIC/ FUEL, AND A BREEDING
 RATIO OF NOT LESS THAN 1.2.

REFERENCES U.S. ATOMIC ENERGY COMMISSION
 NEWS RELEASE F-267 /DEC. 31, 1963/

SEE ALSO STUDY /AC/
 FARET
 SEFOR
 STUDY /WEST/
 LMFBR
 FFTF

AN EVALUATION OF FOUR DESIGN STUDIES OF A 1000 MWE
 CERAMIC-FUELED FAST BREEDER REACTOR.
 CHICAGO OPERATIONS OFFICE, REACTOR ENG. DIV.
 COO-279 /DEC. 1, 1964/

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LIQUID METAL REACTORS, DOMESTIC

FD02

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THE DESIGN OF A 1000 MWE FAST BREEDER REACTOR.
CE KLOTZ, OTHERS
TRANS. ANS, JUNE 1964.

AN EVALUATION OF FOUR DESIGN STUDIES OF A 1000 MWE
CERAMIC FUELED FAST BREEDER REACTOR,
REACTOR ENG. DIV., US AEC
COO-279 /DEC. 1, 1964/

JANUARY 1967

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LIQUID METAL REACTORS, DOMESTIC

FD03

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NAME/OWNER SPUR/SPACE POWER UNIT REACTOR//AGN-USAF

DESIGNER AEROJET-GENERAL NUCLEONICS

PURPOSE R+D, SPACE POWER

TYPE LIQUID METAL COOLED, FAST REACTOR

POWER MWE(MWT) 300 KWE

CRITICAL DEVELOPMENT, NOW PART OF SNAP/50-SPUR PROGRAM

COOLANT LITHIUM OR POTASSIUM

FUEL MATERIAL URANIUM CARBIDE

REMARKS LITHIUM-COOLED FAST REACTOR, A NONBOILING SYSTEM, A POTASSIUM-COOLED BOILING SYSTEM, WERE STUDIED. PAPER STUDY, 300 KWE, SCALE-UP TO 1 MWE, OF A NUCLEAR TURBOELECTRIC UNIT. A 5 TO 6-YEAR PROGRAM FOR AIRRESEARCH AND USAF, PROTOTYPE DEVELOPMENT TARGET 1963, COMPLETE SYSTEM TARGET 1965-66. AGN IS ALSO STUDYING RUBIDIUM AS A COOLANT FOR FAST REACTORS. THE FIRST CIRCULATING RUBIDIUM LOOP WILL OPERATE AT 1600 F WITH 100 POUNDS OF RB. WORKING FLUIDS STUDIED INCLUDED RUBIDIUM, LITHIUM, POTASSIUM, SODIUM, AND CESIUM. DEVELOPMENT FOR SPUR /SPACE POWER UNIT REACTOR/ HAS BEEN PLACED UNDER A JOINT AEC-NASA-AF SNAP-50/SPUR PROGRAM

REFERENCES BOILING VS. NON-BOILING LIQUID METAL COOLED REACTORS.
DL COCHRAN, KE BUCK
ARS SPACE POWER SYSTEMS CONFERENCE, SANTA MONICA, CALIF., SEPTEMBER 27-30, 1960

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LIQUID METAL REACTORS, DOMESTIC

FD04

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NAME/OWNER SRE/SODIUM REACTOR EXPERIMENT//AEC, AI, S, CAL, ED.

DESIGNER ATOMICS INTERNATIONAL

OPERATOR ATOMICS INTERNATIONAL, S. CALIF, EDISON

LOCATION SANTA SUSANA, CALIF.

PURPOSE POWER EXPERIMENT.

TYPE SODIUM-GRAPHITE THERMAL BREEDER

POWER MWE(MWT) 5 20
45 MWT WITH URANIUM CARBIDECRITICAL 1957, CORE 3 IN 1963
SEE REMARKS

COOLANT SODIUM

MODERATOR GRAPHITE, ZIRCONIUM ALLOY CANS
REFLECTOR, GRAPHITEFUEL MATERIAL CORE 1 URANIUM SLUGS 0.75 IN. DIA./6 IN. LONG
CORE 2 CONTAINED THORIUM/URANIUM ALLOY
CORE 3, URANIUM CARBIDE FUEL

FUEL GEOMETRY RODS

FUEL CLADDING SS 0.01 IN. THICK. SODIUM-POTASSIUM BOND

FUEL ENRICH. CORE 1, 2.8 PER CENT U-235
CORE 2, 93.1 PER CENT
CORE 3, 5.2 PER CENTFUEL ASSEMBLY CORE 1, 7-ROD CLUSTER, 43 ASSEMBLIES
CORE 2, 5-ROD CLUSTER
CORE 3, 9-ROD CLUSTER, 33 ASSEMBLIES

FUEL CHARGE CORE 1, 3000 KG. URANIUM

SPECIFIC POWER 240 KW/KG U-235

BURNUP(REFUEL) 2500 MWD/T 300 FULL-POWER DAYS

NEUTRON FLUX THERMAL AVE, 2×10^{13}
WITH URANIUM CARBIDE ELEMENTS 10×10^{14}

CONTROL BORON-NICKEL ALLOY RODS

COOLANT TEMP. INLET 650 F. OUTLET 1200 F. /CORE 3/

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COOLANT PRESS. INLET 6 PSIG

OUTLET 3 PSIG

REACTOR VESSEL FLAT-BOTTOMED OPEN TOP CYLINDER, SS, 1.5 IN. THICK
11 FT, ID./18.87 FT. HIGH, OUTER TANK CARBON STEEL

REMARKS

REACTOR INSTABILITY WAS NOTED AT 2 MWT OPERATION DUE TO THERMAL BOWING OF THE FUEL ELEMENTS. CONSTRAINT WAS IMPOSED BY MEANS OF A HELICAL WIRE WRAP AROUND THE FUEL CLUSTERS, RESULTING IN A REDUCED POWER COEFFICIENT. FUEL ELEMENT MODIFICATIONS WERE COMPLETED IN JANUARY 1962. IN JULY 1963 THE SRE CRITICAL ASSEMBLY ACHIEVED CRITICALITY WITH A FULL CORE LOADING OF 24 UC ELEMENTS, AND THE SRE PRODUCED POWER, ALSO IN JULY 1963, WITH A FULL-SCALE UC ELEMENT IN THE CORE. THE AEC HAS ANNOUNCED THAT IT WILL DEACTIVATE THE REACTOR RATHER THAN CONVERT IT TO HIGH-TEMPERATURE TESTING OF BREEDER FUELS AND MATERIALS. MODIFICATIONS TO RAISE THE POWER FROM 15 MWT TO 30 MWT HAVE BEEN COMPLETED, BUT THE REACTOR WAS NOT OPERATED AFTER SHUT-DOWN IN 1964.

REFERENCES

OPERATING EXPERIENCE WITH THE SODIUM REACTOR EXPERIMENT.
FE FARIS, OTHERS
SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY 9. 493-509 /1958/

SRE OPERATES AGAIN WITH CORE 2 BUT WITH 5 MWT POWER LIMIT.
NUCLEONICS 20. 12 /JANUARY 1962/

PROCEEDINGS OF THE SYMPOSIUM ON SODIUM REACTORS TECHNOLOGY, MAY 24-25, 1961, LINCOLN, NEBRASKA.
TID-7623 /JUNE 1962/

A 200 MWE PROTOTYPE SODIUM COOLED REACTOR HIGH EFFICIENCY POWER PLANT
JA FALCON, PR KEEP
CONF-51-4 /AMERICAN PUBLIC POWER ASSOCIATION ANNUAL CONVENTION, CLEVELAND, APRIL-MAY 1963/

NUCLEONICS WEEK DEC. 6, 1966 P. 2
NEWS RELEASE

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LIQUID METAL REACTORS, DOMESTIC

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NAME/OWNER	SGR-1000/AI LARGE ADVANCED SODIUM-GRAPHITE REACTOR	
DESIGNER	ATOMICS INTERNATIONAL	
PURPOSE	DESIGN, DEVELOPMENT	
TYPE	LIQUID METAL COOLED, THERMAL REACTOR, CALANDRIA	
POWER MWE(MWT)	1000	2550
CRITICAL	DESIGN	
COOLANT	SODIUM	
MODERATOR	GRAPHITE	
FUEL MATERIAL	URANIUM CARBIDE PELLETS 0.500 IN. DIA.	
FUEL GEOMETRY	RODS 14 FT. ACTIVE LENGTH /STACKED SLUGS/	
FUEL CLADDING	SS 0.010 IN. THICK /SODIUM BOND/	
FUEL ENRICH.	3.6 PER CENT U-235	
FUEL ASSEMBLY	18-ROD CLUSTER WITH CENTRAL SUPPORT TUBE 595 ELEMENTS/CORE	
FUEL CHARGE	73.8 TON URANIUM	
SPECIFIC POWER	32 KW/KG URANIUM	
BURNUP(REFUEL)	25,000 MWD/T	6 1/2 MONTHS
CONTROL	RODS	
COOLANT TEMP.	INLET 750 F	OUTLET 1150 F
REACTOR VESSEL	CALANDRIA TANK CONTAINING MODERATOR, SS PROCESS TUBES. CALANDRIA IS A SINGLE LARGE VESSEL. THE PROCESS TUBES PENETRATING THE GRAPHITE AND JOINED TO TOP + BOTTOM OF CALANDRIA BY WELDED JOINTS. FUEL ELEMENTS STAND IN THE PROCESS TUBES. CALANDRIA VESSEL IS SUSPENDED FROM TOP SHIELD.	
CONTAINMENT	STEEL-LINED CONCRETE PIT IN OPERATING FLOOR OF REACTOR BUILDING	
REMARKS	SODIUM COMPONENTS TEST INSTALLATION AT SANTA SUSANA, CALIF. WILL TEST LARGE HEAT TRANSFER	

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SYSTEM COMPONENTS. THE STEAM GENERATORS ARE
MODULAR UNITS.
DESIGN FOR A SINGLE-LOOP, 200 MWE SGR HAS
BEEN COMPLETED.

REFERENCES

DESIGN, PERFORMANCE, AND ECONOMIC EVALUATION OF
SODIUM HEATED, MODULAR SUPERCRITICAL STEAM
GENERATORS.
OF CASEY, OTHERS
NAA-SR-8508

SODIUM-COOLED THERMAL REACTORS.
C STARR, OTHERS
THIRD U.N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964, A/CONF.28/P/206

AN OPTIMIZED CORE DESIGN FOR A 1000 MWE SODIUM-
GRAPHITE REACTOR,
H ROOD
TRANS. ANS. /JUNE 1964/

A 200 MWE PROTOTYPE SODIUM COOLED REACTOR
HIGH EFFICIENCY POWER PLANT,
JA FALCON, PR KEEP
CONF-51-4 /AMER. PUB. POWER ASSOC. ANNUAL
CONVENTION, CLEVELAND, APRIL 1963/

200 MWE PROTOTYPE LARGE SGR REACTOR.
STRUCTURE DESIGN AND EVALUATION
DR ANDERSON, KW FOSTER - EDS.
NAA-SR-11314 /1965/

1000 MWE SGR AND PROTOTYPE EVALUATION STUDY.
ATOMICS INTERNATIONAL
NAA-SR-9213

FEASIBILITY STUDY OF A 1000-MWE SODIUM-COOLED
FAST REACTOR
DT EGGEN, HA MOREWITZ
NAA-SR-11378 /VOL. 3, METHODS DEVELOPMENT/

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LIQUID METAL REACTORS, DOMESTIC

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NAME/OWNER	HALLAM NUCLEAR POWER FACILITY/AEC, CONSUMERS POWER	
DESIGNER	ATOMICS INTERNATIONAL	
OPERATOR	CONSUMERS POWER COMPANY	
LOCATION	HALLAM, NEBRASKA	
PURPOSE	POWER DEMONSTRATION, 1ST ROUND	
TYPE	SODIUM-GRAPHITE THERMAL REACTOR	
POWER MWE(MWT)	75	240
CRITICAL	AUG. 1962, OPERATION. OCT. 1963 SHUT DOWN, TO BE DISMANTLED.	
COOLANT	SODIUM	
MODERATOR	GRAPHITE	
FUEL MATERIAL	URANIUM-MOLYBDENUM ALLOY, SOME URANIUM CARBIDE TEST ELEMENTS, CORE II URANIUM CARBIDE ELEMENTS.	
FUEL GEOMETRY	RODS 0.590 IN. DIA., 13-25 FT. ACTIVE LENGTH	
FUEL CLADDING	SS TUBE 0.660 IN. OD./0.010 IN. THICK	
FUEL ENRICH.	3.6 PER CENT U-235, CORE 2 4.9 PER CENT	
FUEL ASSEMBLY	18-ROD CLUSTER, ZIRCALOY PROCESS TUBE, INITIAL LOADING 137 ELEMENTS	
FUEL CHARGE	29,200 KG. URANIUM	
SPECIFIC POWER	256 KW/KG U-235	
BURNUP(REFUEL)	MAX, 15000 MWD/T	1/3 CORE
NEUTRON FLUX	THERMAL AVE 1×10^{13}	
CONTROL	RODS WITH GADOLINIUM/SAMARIUM OXIDE POISON MATERIAL	
COOLANT TEMP.	INLET 610 F	OUTLET 945 F
REACTOR VESSEL	VERTICAL SS CYLINDER 19 FT. DIA./33 FT. HIGH, OUTER VESSEL OF LOW ALLOY STEEL	
CONTAINMENT	HIGH DENSITY CONCRETE CELLS BELOW LEVEL OF	

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HIGH-BAY FLOOR, CONVENTIONAL BUILDING.

REMARKS

SODIUM COOLANT SYSTEM CONSISTS OF THREE INDEPENDENT CIRCUITS, EACH DIRECTLY CONNECTED TO THE REACTOR VESSEL. THE HALLAM DESIGN HAS BEEN EXTRAPOLATED TO A 360 MWE AND TO A 525 MWE STUDY, THE 525 MWE CENTRAL STATION INCLUDING SUPER-CRITICAL STEAM GENERATION. PRELIMINARY STUDIES HAVE BEGUN ON A 200 MWE PROTOTYPE SGR, WHICH WILL USE URANIUM CARBIDE FUEL. THE REACTOR HAS BEEN SHUT DOWN BECAUSE OF FAILURE OF MODERATOR CLADDING SINCE THE FALL OF 1964. THE AEC HAS ANNOUNCED IT WILL BE DISMANTLED

REFERENCES

THE CONSUMERS PUBLIC POWER DISTRICT SODIUM GRAPHITE REACTOR.

RL OLSON

NAA-SR-2600 /1958/

75,000 KILOWATTS OF ELECTRICITY BY NUCLEAR FISSION AT THE HALLAM NUCLEAR POWER FACILITY, FC GRONEMEYER
AI-5275 /1960/

HALLAM NUCLEAR POWER FACILITY PROTOTYPE FOR ADVANCED SODIUM-COOLED POWER STATIONS, RW DICKINSON, OTHERS
AIEE TRANS. /POWER APP. SYST/, 1008-11 /FEBRUARY 1962/

DESIGN PRACTICE, HALLAM, POWER REACTOR TECHNOLOGY 5, 39-51 /JUNE 1962/

A HIGH-PERFORMANCE SODIUM-GRAPHITE REACTOR POWER PLANT, RW DICKINSON
ASME PREPRINT 62-WA-261 /1962/

FINAL SUMMARY SAFEGUARDS REPORT FOR THE HALLAM NUCLEAR POWER FACILITY, AND SUPPLEMENT, ATOMICS INTERNATIONAL,
NAA-SR-5700 /APRIL 15, 1961/
NAA-SR-5700 /SUPPL.4/ /DEC. 1, 1961/

1000 MWE SGR AND PROTOTYPE EVALUATION STUDY /VOL. I/ AND VOL. II, 200 MWE SGR PROTOTYPE DESIGN ATOMICS INTERNATIONAL
NAA-SR-9213 /DEC. 1963/

FINAL EVALUATION REPORT, HALLAM NUCLEAR POWER

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FACILITY,

JE PRICE, COMP,

NAA-SR-9777 /VOLS. 1-6/ /SEPT. 29, 1964/

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LIQUID METAL REACTORS, DOMESTIC

FD07

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NAME/OWNER AETR/ADVANCED EPITHERMAL THORIUM BREEDER//AEC, SAEA
 PURPOSE POWER EXPERIMENT.
 TYPE LIQUID METAL COOLED EPITHERMAL BREEDER
 POWER MWE(MWT) 360 900
 CRITICAL DEVELOPMENT
 COOLANT SODIUM
 MODERATOR BERYLLIUM OR GRAPHITE
 FUEL MATERIAL THORIUM-URANIUM ALLOY.
 FUEL GEOMETRY FOLDED-PLATE
 FUEL CLADDING SS OR LOW-ALLOY STEEL
 FUEL ASSEMBLY CRITICAL EXPERIMENT, SS-CLAD PLATELETS OF URANIUM
 OXIDE
 TEST CORE MOCKUP, THORIUM CARBIDE/U-233
 U-238 AND PU-235 WERE STUDIED AS FISSILE
 MATERIALS, AND THORIUM AND U-233 OR U-235
 SYSTEMS.
 REMARKS R+D, PILOT PLANT PLANNED, CRITICAL EXPERIMENTS IN
 PROGRESS, SAEA, WITH GE, W. GERMANY, EURATOM, AND
 AEC, WILL COOPERATE IN THE CONSTRUCTION OF A
 LIQUID METAL COOLED FAST BREEDER TEST PLANT AT
 FAYETTEVILLE, ARK, SEE SEFOR.
 REFERENCES ADVANCED THORIUM REACTOR,
 S SIEGEL
 BNL-483 /P. 9/ /1958/
 EPITHERMAL REACTOR SHOWS PROMISE FOR COMPETITIVE
 NUCLEAR POWER,
 ELECTRICAL WORLD 154. 52-4 /JULY 25, 1960/
 EPITHERMAL THORIUM REACTORS,
 DT EGGEN
 TID-7560 /P. 148-71/ /1962/
 THE EPITHERMAL REACTOR WITH THORIUM /AETR/
 DT EGGEN
 IND-ATOMIQUES 6. 63-78 /N. 11/12, 1962/

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LIQUID METAL REACTORS, DOMESTIC

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NAME/OWNER PASTE FUEL REACTOR STUDY/AI

DESIGNER ATOMICS INTERNATIONAL

PURPOSE STUDY

TYPE LIQUID METAL COOLED, PASTE FUEL, FAST REACTOR

POWER MWE(MWT) 300 704

CRITICAL STUDY

COOLANT SODIUM

MODERATOR GRAPHITE REFLECTOR

FUEL MATERIAL URANIUM CARBIDE IN SODIUM AS A PASTE

FUEL CLADDING CORE AND BLANKET STRUCTURE STAINLESS STEEL

REACTOR VESSEL CYLINDRICAL, CORE 5 FT. DIA. / 5 FT. HIGH.

REMARKS THE CORE STRUCTURAL MATERIAL IS STAINLESS STEEL, RADIAL BLANKET USES NATURAL URANIUM CARBIDE IN SODIUM AS A PASTE AND IS SURROUNDED BY A RADIAL GRAPHITE REFLECTOR, URANIUM METAL, URANIUM OXIDE, PLUTONIUM/URANIUM CARBIDE, PLUTONIUM/URANIUM METAL, AND PLUTONIUM/URANIUM DIOXIDE HAVE ALSO BEEN STUDIED.

REFERENCES OPTIMIZATION STUDIES ON PASTE-FUEL REACTORS
JM ZETTERBAUM, TW KERLIN
NAA-SR-MEMO-5996 /DEC. 28, 1960/

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LIQUID METAL REACTORS. DOMESTIC

FD09

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NAME/OWNER EBR-1 /EXP. BREEDER REACTOR-1//AEC
 DESIGNER ARGONNE NATIONAL LABORATORY
 OPERATOR ARGONNE NATIONAL LABORATORY
 LOCATION NATIONAL REACTOR TEST STATION, IDAHO
 PURPOSE POWER EXPERIMENT
 TYPE LIQUID METAL COOLED, FAST BREEDER
 POWER MWE(MWT) 0.2 1.4
 CRITICAL MARK 1, 1951.
 MARK 4, 1962
 RETIRED DEC, 1963
 COOLANT SODIUM-POTASSIUM NAK
 MODERATOR URANIUM REFLECTOR
 FUEL MATERIAL URANIUM-ZIRCONIUM SLUGS. SEE REMARKS
 FUEL GEOMETRY ROD. SEE REMARKS
 FUEL CLADDING SS, 0.022 IN. THICK. SEE REMARKS
 FUEL ENRICH. 93.2 PER CENT U-235. SEE REMARKS
 FUEL ASSEMBLY SINGLE ROD ELEMENT, 217 TO CORE.
 SEE REMARKS
 SPECIFIC POWER 23 KW/KG U-235
 BURNUP(REFUEL) 0.3 PER CENT
 NEUTRON FLUX FAST AVE. 0.8×10^{14}
 CONTROL MOVABLE URANIUM REFLECTOR
 COOLANT TEMP. INLET 442 F OUTLET 601 F
 COOLANT PRESS. 13 PSIG
 REACTOR VESSEL SS VESSEL, 15.87 IN. ID.
 CONTAINMENT CONCRETE SHIELDING, CONVENTIONAL BUILDING.
 REMARKS THE MARK-3 CORE HAD FUEL RODS ASSEMBLED INTO

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HEXAGONAL UNITS OF 36 RODS EACH, CONTAINED IN
HEXAGONAL STAINLESS STEEL TUBES. IN 1961 EBR-I
WAS SHUT DOWN FOR INSTALLATION OF A PLUTONIUM
CORE. THE MARK-4 CORE WAS CRITICAL ON NOV. 27,
1962 ON ELEMENTS CONSISTING OF PLUTONIUM ALUMINUM
RODS CLAD IN ZIRCALOY, SURROUNDED BY AN INNER
BLANKET OF NATURAL URANIUM RODS AND AN OUTER
BLANKET OF NATURAL URANIUM BRICKS. THE MARK-4
CORE HAS PRODUCED 1.8 KWE OF POWER ON PLUTONIUM
FUEL. PLANT WAS RETIRED DECEMBER, 1963.

REFERENCES

EBR-I, MARK-3, DESIGN REPORT.
ARGONNE NATIONAL LABORATORY
ANL-5836 /MARCH 1958/

SAFETY ANALYSIS REPORT, EBR-1 MARK-4
RO HAROLDSEN, OTHERS
ANL-6411 /FEB. 1963/

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NAME/OWNER EBR-2/EXP. BREEDER REACTOR-2//AEC
 DESIGNER ARGONNE NATIONAL LABORATORY
 OPERATOR ARGONNE NATIONAL LABORATORY
 LOCATION NATIONAL REACTOR TEST STATION, IDAHO
 PURPOSE POWER EXP.-FAST BREEDER
 TYPE LIQUID METAL COOLED FAST BREEDER
 POWER MWE(MWT) 20 60 /SEE REMARKS
 CRITICAL NOV. 1963
 COOLANT SODIUM
 FUEL MATERIAL FISSION ALLOY, BLANKET DEPLETED URANIUM
 CORE 2 URANIUM-PLUTONIUM-FISSION ALLOY
 FUEL GEOMETRY PINS, CORE 0.144 IN. DIA./14.22 IN. LONG + UPPER
 AND LOWER BLANKET ASSEMBLY AND INNER AND OUTER
 BLANKET ASSEMBLIES
 FUEL CLADDING SS HEXAGONAL CAN 0.009 IN. THICK.
 FUEL ENRICH. 49 PER CENT U-235
 FUEL ASSEMBLY CORE, 91-ELEMENT ASSEMBLY, 14.22 IN. ACT. LENGTH
 INNER AND OUTER BLANKET, 19-ELEMENT ASSEMBLY,
 55 IN. LONG.
 UPPER AND LOWER BLANKET 19-ELEMENT ASSEMBLY, 18
 IN. LONG
 FUEL CHARGE 350 KG, URANIUM, 28,100 KG, DEPLETED URANIUM
 SPECIFIC POWER 154 KW/KG U
 BURNUP(REFUEL) FRACTIONAL
 NEUTRON FLUX FAST AVE. ABOVE 1.35 MEV 0.8×10^{15}
 FAST AVE. BELOW 1.35 MEV 2.97×10^{15}
 CONTROL MODIFIED FUEL ASSEMBLIES, VERTICAL MOTION
 COOLANT TEMP. INLET 700 F OUTLET 900 F
 REMARKS CRITICALITY WAS ACHIEVED ON A LIQUID SODIUM
 COOLANT ON NOV. 11, 1963. INITIAL OPERATION WILL

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BE ON U-235 AS FUEL, LATER WITH PLUTONIUM, THE PLANT IS INTEGRATED WITH A FUEL PROCESSING FACILITY, THE REACTOR WAS SHUT DOWN IN OCT. 1964 WITH CONTROL ROD PROBLEMS, OPERATION STARTED IN APRIL 1965, BUT WILL BE LIMITED TO 15 MWE FOR REMAINDER OF LIFE OF 1ST CORE, WHEN SODIUM PUMP WILL BE REPLACED.

REFERENCES

EXPERIMENTAL BREEDER REACTOR 2 /EBR-2/, HAZARD SUMMARY REPORT,
LJ KOCH, OTHERS
ANL-5719 /MAY 1957/

CONSTRUCTION DESIGN OF EBR-2, AN INTEGRATED UNMODERATED NUCLEAR POWER PLANT,
LJ KOCH, OTHERS
SECOND U. N. INTL. CONF, ON THE PEACEFUL USES OF ATOMIC ENERGY 9. 323-5 /1958/

EBR-2, A CLOSED CYCLE FAST BREEDER,
NUCLEAR ENG. 7. 356-7 /SEPTEMBER 1962/

ADDENDIUM TO HAZARD SUMMARY REPORT,
EXPERIMENTAL BREEDER REACTOR-2 /EBR-2/
LJ KOCH, OTHERS
ANL-5719 /ADD./ /JAN. 7, 1964/

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LIQUID METAL REACTORS, DOMESTIC

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NAME/OWNER LUNAR POWER PLANT

DESIGNER ARGONNE NATIONAL LABORATORY

PURPOSE LUNAR POWER PLANT.

TYPE LIQUID METAL COOLED, MERCURY VAPOR TURBINE
FAST REACTOR

POWER MWE(MWT) 1

CRITICAL STUDY

COOLANT BOILING MERCURY

FUEL MATERIAL URANIUM CARBIDE OR URANIUM

FUEL ENRICH. IF URANIUM METAL, SOME ENRICHMENT

FUEL ASSEMBLY RODS, BOLTED RATHER THAN JACKETED,
1381 RODS/CORE

BURNUP(REFUEL) 2-YEAR OPERATION

CONTAINMENT NO SHIELDING

REMARKS REACTOR IS SIMILAR TO EBR-1 MARK 3, WITH BOLTED
RATHER THAN JACKETED CORE FUEL RODS. ALL SURFACES
IN CONTACT WITH THE COOLANT WOULD BE A CHROMIUM-
MOLYBDENUM STEEL ALLOY. FOLDABLE RADIATORS
REMOVE CONDENSATION HEAT FROM THE MERCURY CYCLE.
SYSTEM USES THE RANKINE CYCLE. A COMPLETE
POWERPLANT CONSISTS OF 3 IDENTICAL UNITS.
CONCEPT IS FOR FABRICATION ON EARTH, DIRECT LAUNCH
AS PAYLOAD OF AN ADVANCED SATURN OR NOVA VEHICLE,
SOFT LANDING ON MOON.

REFERENCES NUCLEAR POWER PLANT FOR MOON OUTLINED,
EH KOLCUM
AVIATION WEEK 75. 50-53 /JULY 31, 1961/

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LIQUID METAL REACTORS, DOMESTIC

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NAME/OWNER	FARET /ARGONNE FAST REACTOR TEST FACILITY//AEC	
DESIGNER	ARGONNE NATIONAL LAB., ATOMICS INTERNATIONAL TITLE 1 AND 2 DESIGNS BY BECHTEL	
OPERATOR	ARGONNE NATIONAL LABORATORY	
LOCATION	NATIONAL REACTOR TEST STATION, IDAHO	
PURPOSE	FAST REACTOR EXPERIMENTAL FACILITY.	
TYPE	LIQUID METAL COOLED FAST REACTOR TEST FACILITY	
POWER MWE(MWT)	0	50
CRITICAL	DROPPED, SEE REMARKS.	
COOLANT	SODIUM	
FUEL MATERIAL	URANIUM/PLUTONIUM DIOXIDE PELLETS URANIUM/PULTONIUM CARBIDE, VIBRATORY COMPACTED URANIUM/PLUTONIUM ALLOY	
FUEL GEOMETRY	RODS	
FUEL ASSEMBLY	CERAMIC FUEL, 37-ELEMENT ASSEMBLY 24 ASSEMBLIES ALLOY FUEL, 61-ELEMENT ASSEMBLY 8 ASSEMBLIES CARBIDE FUEL, 16 ASSEMBLIES	
COOLANT TEMP.	INLET 600-960 F	OUTLET 840-1200 F
REACTOR VESSEL	DOUBLE-WALLED OUTER VESSEL AS AN INTEGRAL PART OF THE HEAT TRANSFER SYSTEM, AN INNER CORE-SUPPORT STRUCTURE AND REMOVABLE COVER.	
CONTAINMENT	REINFORCED-CONCRETE STEEL-LINED CELL, NORMALLY FILLED WITH HIGH PURITY INERT GAS.	
REMARKS	FARET HAS BEEN DROPPED IN FAVOR OF THE LARGER FFTF FAST FLUX TEST FACILITY. SEE FD30	
REFERENCES	FARET-A FAST-REACTOR TEST FACILITY A SMAARDYK, OTHERS TRANS. ANS 5.435-6 /NOV. 1962/ /ABSTRACT/ NUCLEONICS WEEK DEC. 2, 1965 P. 1 NEWS RELEASE	

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FAST REACTOR TEST FACILITY FARET
VOL. 1, DESCRIPTION AND PROGRAM
ARGONNE NATIONAL LAB.
ANL-7168, VOL.1 /MARCH 1966/

FARET CORE#1 REFERENCE DESIGN,
PJ PERSIANI, OTHERS
ANL-7120 P, 766-75 /1966/

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NAME/OWNER ENRICO FERMI ATOMIC POWER PLANT/PRDC
 DESIGNER ATOMIC POWER DEVELOPMENT ASSOCIATES, INC.
 OPERATOR POWER REACTOR DEVELOPMENT COMPANY
 LOCATION MONROE, MICHIGAN
 PURPOSE POWER DEMONSTRATION
 TYPE LIQUID METAL COOLED FAST BREEDER
 POWER MWE(MWT) 60 200
 INITIAL 110 MWT
 CRITICAL AUG. 1963. SEE REMARKS
 COOLANT SODIUM
 FUEL MATERIAL URANIUM-MOLYBDENUM ALLOY
 FUEL GEOMETRY ROD. CORE, ACT. LENGTH 30.5 IN.
 UPPER AND LOWER AXIAL BLANKET 14.0 IN. LONG
 RADIAL BLANKET 61.75 IN. LONG
 FUEL CLADDING CORE ZIRCONIUM 0.005 IN. THICK
 BLANKET SS 0.005 IN. THICK
 FUEL ENRICH. 25.6 PER CENT U-235
 BLANKET DEPLETED URANIUM
 FUEL ASSEMBLY CORE 1
 105-PIN ASSEMBLY, CORE AND BLANKET ASSEMBLIES
 ENCLOSED IN SS TUBE, PLUS RADIAL BLANKET
 ASSEMBLIES.
 FUEL CHARGE 2000 KG. URANIUM
 SPECIFIC POWER 675 KW/KG U-235
 BURNUP(REFUEL) 48,800 MWD/T
 NEUTRON FLUX 1.6×10^{15}
 CONTROL RODS
 COOLANT TEMP. INLET 550 F OUTLET 800 F
 COOLANT PRESS. INLET 82 PSIG
 REACTOR VESSEL SS VESSEL 14 FT. 2 IN. ID. /SODIUM POOL/

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VESSEL IS IN TWO PARTS, THE LOWER CONTAINING THE CORE. VESSEL IS ENCLOSED IN A CARBON STEEL LEAK-TIGHT VESSEL.

CONTAINMENT WELDED STEEL BUILDING.

REMARKS INITIAL CRITICALITY IN AUG. 1963 WAS FOLLOWED BY A PROGRAM OF LOW-POWER TESTS LEADING UP TO 200 MW. THE FERMI REACTOR WILL BE OPERATED AT A SUSTAINED 110 MWE WITH CORE A. TEST FUELS AND MATERIAL SPECIMENS WILL BE TESTED. FERMI WAS SHUT DOWN OCT. 5, 1966 FOLLOWING A MALFUNCTION PROBABLY INVOLVING FUEL MELTING IN ONE OR MORE SUBASSEMBLIES. SIGNIFICANT DAMAGE IS THOUGHT TO HAVE OCCURED.

REFERENCES DESCRIPTION OF DEVELOPMENTAL FAST NEUTRON BREEDER POWER REACTOR PLANT
APDA-108 /SEPTEMBER 1955/

ENRICO FERMI ATOMIC POWER PLANT,
A.P. DUNNELL, OTHERS
SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY 8, 535-42 /1958/

ENRICO FERMI POWER PLANT,
APDA-124 /JANUARY 1959/

CIVILIAN POWER REACTOR PROGRAM. PART 3, STATUS
REPORT ON FAST REACTORS AS OF 1959,
TID-8518 /1/ BOOK I

ENRICO FERMI ATOMIC POWER PLANT REVISED LICENSE
APPLICATION. PART B. TECHNICAL INFORMATION AND
HAZARDS SUMMARY REPORT.
POWER REACTOR DEVELOPMENT COMPANY
NP-10458 /JULY 1961/

A REPORT ON FERMI,
OJ DU TEMPLE
NUCLEAR NEWS /ANS/ 7, 28-33 /JAN. 1964/

THE ENRICO FERMI FAST NEUTRON BREEDER,
DESCRIPTION AND OPERATION
J.F. ANDERSON /PRDC/
CONF-631201 /P, 9-16/
PRDC, FAST NEUTRON BREEDER REACTOR CONF, DEC. 1963

ENRICO FERMI POWER PLANT - IRRADIATION TEST
FACILITY.

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PR HUEBOTTER, WH JENS
ASME 65-WA/NE-5

NUCLEONICS WEEK OCT. 13, 1966 P. 1
NEWS RELEASE

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NAME/OWNER PASTE FUEL REACTOR/APDA

DESIGNER ATOMIC POWER DEVELOPMENT ASSOCIATES, INC.

PURPOSE POWER EXP. STUDY

TYPE LIQUID METAL COOLED, FAST BREEDER

POWER MWE(MWT) 300 900

CRITICAL DESIGN

COOLANT SODIUM

FUEL MATERIAL PLUTONIUM-URANIUM-FISSIUM EQUILIBRIUM MIXTURE IN
SODIUM
BLANKET, URANIUM-238/MOLYBDENUM

FUEL GEOMETRY PASTE

FUEL ASSEMBLY CORE AND BLANKET SHELL-AND-TUBE WITH FUEL PASTE
ON SHELL SIDE AND COOLANT ON TUBE SIDE,
DIVISION IS INTO 19 CORE AND 12 BLANKET
SUBASSEMBLIES

SPECIFIC POWER 2000 KW/KG

COOLANT TEMP. INLET 600 F OUTLET 900 F

REACTOR VESSEL SS VESSEL 13 3/4 FT. HIGH, 5.5 FT. DIA.

REFERENCES SUMMARY OF THE APDA FUEL DEVELOPMENT PROGRAMS.
WG BLESSING, OTHERS
APDA-143 /APRIL 1961/

CONCEPTUAL DESIGN OF A 300 MWE PASTE FUELED FAST
BREEDER POWER REACTOR
ATOMIC POWER DEV. ASSOC.
APDA-146 /OCT. 1961/

MOBILE-FUELED FAST REACTORS
EC KOVACIC
FAST REACTOR TECHNOLOGY, NATIONAL TOPICAL MEETING
APRIL 26-28, 1965. AMERICAN NUCLEAR SOC.
ANS-100 /P. 75-81/

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NAME/OWNER LMTBR/LIQ, METAL THORIUM BREEDER REACTOR/
 DESIGNER BABCOCK AND WILCOX
 PURPOSE FAST BREEDER, POWER, DESIGN STUDY.
 TYPE LIQUID METAL COOLED, MOBILE FUEL, BREEDER REACTOR
 POWER MWE(MWT) 500 1065
 CRITICAL STUDY
 COOLANT BISMUTH, /URANIUM-BISMUTH SOLUTION/
 MODERATOR GRAPHITE
 REFLECTOR, GRAPHITE
 FUEL MATERIAL URANIUM SOLUTION IN BISMUTH
 BLANKET, THORIUM OXIDE-BISMUTH SLURRY
 FUEL GEOMETRY SOLUTION AND SLURRY
 FUEL CHARGE 620 KG, FUEL /TOTAL INVENTORY/
 SPECIFIC POWER 1.7 MWH/KG
 BURNUP(REFUEL) CORE FLUID REPROCESSING TIME 15.7 FULL POWER DAYS,
 BLANKET 155
 NEUTRON FLUX CORE, THERMAL AVE. 7.2×10^{14}
 EPITHERMAL AVE. 2.6×10^{15}
 BLANKET, THERMAL AVE. 3.4×10^{13}
 EPITHERMAL AVE. 1.3×10^{14}
 CONTROL RODS
 COOLANT TEMP. INLET 1000 F OUTLET 1300 F /CORE/
 INLET 1150 F OUTLET 1300 F /BLANKET/
 COOLANT PRESS. 250 PSI
 REACTOR VESSEL SS CYLINDER 15 FT 10 IN. ID./18 FT. 6 IN. LONG.
 LOW C STEEL INNER CLADDING.
 REMARKS AN EXTERNALLY COOLED CONCEPT FOR A BREEDER REACTOR
 USING URANIUM-BISMUTH SOLUTION AS FUEL-COOLANT
 AND A THORIUM OXIDE-BISMUTH SLURRY BLANKET,
 INTEGRATED ON-SITE CHEMICAL PROCESSING PLANT. THE
 CORE FLUID FLOW IS UPWARD THROUGH THE BOTTOM
 END-BLANKET, CORE, TOP END-BLANKET AND PLENUM INTO

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CORE FLUID HEAT EXCHANGER /TUBE-SIDE/. BLANKET FLUID FLOWS UPWARD FROM THE INNER BOTTOM PLENUM, THROUGH CRUCIFORM CHANNELS IN THE CORE AND THE INNER SIDE-BLANKET CHANNELS, UP THROUGH TOP END-BLANKET AND HORIZONTAL PASSAGES TO TOP INNER PLENUMS. REFERENCE DESIGN IS FOR A TWO-REACTOR /1000 MWE/ PLANT. CORE FLUID HEAT EXCHANGER IS A BAYONET-TYPE TANTALUM UNIT, BLANKET FLUID EXCHANGER HASTELLOY-X AND TANTALUM.

REFERENCES

THE LIQUID METAL THORIUM BREEDER REACTOR.
BABCOCK + WILCOX CO.
BAW-1171 /1960/

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 NAME/OWNER SETTLED BED FAST REACTOR/BNL
 SBFR
 DESIGNER BROOKHAVEN NATIONAL LABORATORY
 PURPOSE PRELIMINARY STUDY, FAST BREEDER POWER REACTOR.
 TYPE LIQUID METAL COOLED, SETTLED BED, FAST BREEDER
 POWER MWE(MWT) 1000 2500
 CRITICAL REFERENCE DESIGN
 COOLANT SODIUM
 MODERATOR NONE
 FUEL MATERIAL URANIUM/PLUTONIUM CARBIDE, HYPOSTOICHIOMETRIC
 FUEL GEOMETRY SPHERES 0.120 IN. DIA.
 FUEL CLADDING NONE
 FUEL ENRICH. URANIUM/PLUTONIUM 7/1, DEPLETED URANIUM
 FUEL ASSEMBLY CORE AND BLANKET AS BEDS OF SMALL, RANDOMLY-PACKED
 FUEL SPHERES. COOLANT FLOW IS DOWNWARD,
 RESTRAINING THE BED. THE BED IS SUPPORTED BY
 PERFORATED PLATE.
 ANNULAR CORE 6 FT. 9 IN. OD., 4 FT. 9 IN. ID.,
 10 FT. 6 IN. HIGH, IS SURROUNDED ON ALL SIDES BY
 BLANKET MATERIAL. CENTRAL BLANKET IS 4 FT. DIA.
 FUEL CHARGE TOTAL WEIGHT OF FUEL IS 21,154 KG.
 SPECIFIC POWER 1100 KW/KG PLUTONIUM CARBIDE
 BURNUP(REFUEL) 100,0000 MWD/T
 CONTROL RODS, WITHIN CORE RING
 COOLANT TEMP. INLET 550 F OUTLET 1200 F
 COOLANT PRESS. INLET 316 PSIG OUTLET 20 PSIG
 REACTOR VESSEL CYLINDRICAL, SS VESSEL
 16 FT. 10 IN. ID., 18 FT. HIGH, 5 IN. WALL
 PRESSURE VESSEL
 PERFORATED PLATES FORM THE FUEL BEDS
 CONTAINMENT VERTICAL STEEL CYLINDER 115 FT. ID., 168 FT. HIGH

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65 FT. BELOW-GRADE,
PRESSURE VESSEL.
REACTOR, RADIOACTIVE COOLANT, AND FUEL
HANDLING SYSTEMS ARE BELOW OPERATING FLOOR.

REMARKS

TWO GENERAL REACTOR CONFIGURATIONS WERE STUDIED, AXIAL AND RADIAL FLOW DESIGNS. A ZERO-POWERED, COLD CRITICAL EXPERIMENT CONSISTING OF A TWO-REGION WATER-MODERATED FACILITY WITH A CENTRALLY LOCATED SETTLED BED IS PLANNED, TO BE FOLLOWED BY A LOW POWER, HOT CRITICAL EXPERIMENT USING CERAMIC FUEL LUMPS AND SODIUM COOLANT. A SIMILAR STUDY IS CONCERNED WITH URANIUM/PLUTONIUM DIOXIDE AND URANIUM DIOXIDE SPHERES AS BLANKET. POWER IS 359 MWE AND 881 MWE. DESIGN CONCEPTS FOR A 1000 MWE VERSION HAVE BEEN DONE. AXIAL TYPE WAS SELECTED FOR REFERENCE DESIGN

REFERENCES

CHARACTERISTICS OF FAST SETTLED BED REACTORS.
J CHERNICK
BNL-7592 /OCT. 1963/

NUCLEAR PARAMETER STUDIES OF THE FAST SETTLED BED REACTOR.
MM LEVINE, A ARONSON
BNL-7593 /OCT. 1963/

SETTLED-BED FUEL REACTORS.
LP HATCH, OTHERS
BNL-5830 /NOV. 1961/

PROC. CONFERENCE IN BREEDING, ECONOMICS, AND SAFETY IN LARGE FAST POWER REACTORS, OCTOBER 7-10, 1963.
ARGONNE NATIONAL LAB.
ANL-6792 /DEC. 1963/

NUCLEAR PARAMETER STUDIES OF THE FAST SETTLED BED REACTOR.
J CHERNICK, OTHERS.

1000 MWE SETTLED-BED FAST REACTOR PHYSICS.
A ARONSON, MM LEVINE
AMERICAN NUCLEAR SOC. TRANS, 7. 240-1 /NOV. 1964/

THE SETTLED-BED FAST REACTOR CONCEPT.
L. GREEN, OTHERS /BNL/
NUCLEAR APPLICATIONS 1. 107-130 /APRIL 1965/

SETTLED-BED FAST REACTOR CONCEPT - STATUS REPORT.

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C ROSEMAN, OTHERS
FAST REACTOR TECHNOLOGY, NATIONAL TOPICAL MEETING
APRIL 26-8, 1965. AMERICAN NUCLEAR SOCIETY,
ANS-100 P, 68-74

THE RANDOMLY-PACKED SETTLED-BED FAST REACTOR
CONCEPT, 1000 MWE REACTOR DESIGN
L GREEN, MM LEVINE, EDS.
BNL-887 /JUNE 1, 1965/

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NAME/OWNER LMFBR /LIQ. METAL FAST BREEDER REACTOR/CE

DESIGNER COMBUSTION ENGINEERING, INC.

PURPOSE DESIGN STUDY, FAST BREEDER POWER REACTOR.

TYPE LIQUID METAL COOLED FAST BREEDER

POWER MWE(MWT) 1000 2143

CRITICAL DESIGN STUDY

COOLANT SODIUM

FUEL MATERIAL CORE, URANIUM/PLUTONIUM CARBIDE PELLETS
0.26 IN. DIA.
BLANKET, AXIAL AND RADIAL, 0.4 IN. DIA. PELLETS

FUEL GEOMETRY RODS 30 IN. ACTIVE LENGTH + TOP AND BOTTOM
BLANKET 18 IN.
RADIAL BLANKET 54 IN. ACTIVE LENGTH

FUEL CLADDING SS 0.011 IN. THICK, SODIUM BOND

FUEL ENRICH. AVERAGE 13 PER CENT

FUEL ASSEMBLY CORE, 169-PIN ASSEMBLY, INCLUDING AXIAL BLANKET.
RADIAL BLANKET, 127-ROD ASSEMBLY
157 CORE ASSEMBLIES
156 RADIAL BLANKET ASSEMBLIES

FUEL CHARGE 1155 KG. FISSILE METAL. BLANKET 106 KG.

SPECIFIC POWER 1680 KW/KG FISSILE

BURNUP(REFUEL) 100,000 MWD/T 1/8 CORE AND 1/24 BLANKET
URANIUM + PLUTONIUM

CONTROL RODS, BORON CARBIDE AND DEPLETED URANIUM CARBIDE

COOLANT TEMP. INLET 850 F OUTLET 1120 F

REACTOR VESSEL STRUCTURAL MATERIALS STAINLESS STEEL. REACTOR
VESSEL CONTAINS CORE AND BLANKET ASSEMBLIES.

REFERENCES LIQUID METAL FAST BREEDER REACTOR DESIGN STUDY.
VOL. 1 AND 2.
COMBUSTION ENGINEERING, NUCLEAR DIV.
CEND-200 /VOL. 1 AND 2/ /JANUARY 1964/

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AN EVALUATION OF FOUR DESIGN STUDIES OF A 1000 MWE
CERAMIC FUELED FAST BREEDER REACTOR.
REACTOR ENG. DIV, CHICAGO OPERATIONS OFFICE.
COO-279 /DEC. 1, 1964/

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NAME/OWNER LIMB /LIQUID METAL BREEDER//DOUGLAS AIRCRAFT

DESIGNER DOUGLAS AIRCRAFT

PURPOSE DESIGN, EVALUATION

TYPE LIQUID METAL THERMAL BREEDER, INTERNALLY COOLED

POWER MWE(MWT) 200

COOLANT MOLTEN LEAD

MODERATOR GRAPHITE

FUEL MATERIAL URANIUM-BISMUTH SOLUTION, BLANKET SOLUTION A
DISPERSION OF THORIUM-BISMUTHIDE IN MOLTEN LEAD-
BISMUTH.

FUEL ENRICH. NATURAL

FUEL ASSEMBLY GRAPHITE FUEL ELEMENT IS HEXAGONAL, A CENTRAL
PLUNGER, MOVING DOWNWARD, DISPLACES THE FUEL FLUID
COLLECTED IN THE BOTTOM OF THE OUTER GRAPHITE TUBE
UPWARD INTO THE CORE ZONE. AT CRITICALITY A
RESERVOIR IS FORMED ABOVE THE UPPER BLANKET
REGION, BLANKET FLUID CIRCULATES FROM TOP TO
BOTTOM BY MEANS OF CHANNELS IN THE PLUNGER, CORE,
UPPER AND LOWER BLANKETS ARE FORMED BY A CLUSTER
OF THE GRAPHITE ELEMENTS.

SPECIFIC POWER 4050 KW/KG

NEUTRON FLUX THERMAL AVE, 2.16×10^{14}
EPITHERMAL AVE, 5.43×10^{14}

COOLANT TEMP. 500 C

REACTOR VESSEL STEEL VESSEL CONTAINING A GRAPHITE STRUCTURE
FABRICATED TO CONDUCT THE COOLANT, FUEL, AND
BLANKET FLUIDS THROUGH THE REACTOR.

REMARKS TWO SIZES WERE SELECTED FOR DETAILED EVALUATION,
THE 200 MWT PLANT AND A 1000 MWT PLANT, SINGLE
UNIT CONSTRUCTION FOR ALL REACTOR FUNCTIONS,
INCLUDING PROCESSING BY MOLTEN SALT PROCESS, IS
PROPOSED.

REFERENCES LIQUID METAL BREEDER REACTOR /LIMB/
RJ TEITEL /DOUGLAS AIRCRAFT/
PROC. THORIUM FUEL CYCLE SYMPOSIUM, P. 210-43

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TID-7650 /1962/

LIQUID METAL BREEDER REACTOR /LIMB/ NUCLEAR
EVALUATION.

RJ TEITEL, JB BROWN /DOUGLAS AIRCRAFT/

NUCLEAR APPLICATIONS 1/1/. 13-24 /FEB, 1965/

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NAME/OWNER SEFOR /SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR/
GE, SAEA, W. GERMANY, EURATOM, AEC

DESIGNER GENERAL ELECTRIC COMPANY

LOCATION FAYETTEVILLE, ARKANSAS

PURPOSE EXPERIMENTAL FACILITY, FAST BREEDER POWER REACTOR

TYPE LIQUID METAL COOLED, FAST BREEDER EXPERIMENT

POWER MWE(MWT) 0 20

CRITICAL CONSTRUCTION 1964-5

COOLANT SODIUM, TWO PARALLEL LOOPS

MODERATOR BERYLLIA REFLECTOR

FUEL MATERIAL PLUTONIUM/URANIUM DIOXIDE PELLETS, URANIUM DIOXIDE
PELLETS, BLANKET

FUEL GEOMETRY RODS 1.00 IN. DIA., ACTIVE LENGTH 33.8 IN.

FUEL CLADDING SS 0.055 IN. THICK

FUEL ENRICH. 16 PER CENT PLUTONIUM

FUEL ASSEMBLY 6 RODS/CHANNEL, CENTER ROD IS AN EXPANDABLE
ASSEMBLY CONTAINING BERYLLIUM OXIDE, 618 RODS
TOTAL,
109 CHANNELS, HEXAGONAL

NEUTRON FLUX AVE. 3.4×10^{14}

CONTROL MOVABLE REFLECTOR CONTROL RODS, SURROUNDING CORE
OUTSIDE REACTOR VESSEL.

COOLANT TEMP. INLET 700 F OUTLET 820 F

REACTOR VESSEL LOWER -CORE- SECTION SMALL DIA., UPPER SECTION
LARGE DIA, SHIELDING.

CONTAINMENT OUTER ALL-WELDED STEEL CYLINDER, 50 FT. DIA.,
105.5 FT. HIGH, INNER STEEL LINER, INNER
REINFORCED CONCRETE, STEEL-LINED VESSEL
AIR REGION BETWEEN STEEL-LINED CELLS IS COOLED
AND VENTILATED.

REMARKS PROGRAM HAS BEEN UNDER AEC SPONSORSHIP SINCE 1959.

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FUEL TEST ON PLUTONIUM/URANIUM OXIDE FUELS ARE IN PROGRESS. THE PROGRAM CALLS FOR CONSTRUCTION OF A 10-50 MWT EXPERIMENTAL FAST REACTOR, FOLLOWED BY A PROTOTYPE IN THE 100-300-MWE RANGE FOR OPERATION BY 1970, AND CONSTRUCTION OF A 500 MWE REACTOR TO BE ON-LINE BY 1975. DESIGN STUDIES HAVE INCLUDED A 500 MWE REACTOR, WITH DETAILED PHYSICS AND CORE ANALYSIS /REFERENCE FOR DESIGN/. FUEL WOULD BE PLUTONIUM/URANIUM DIOXIDE RODS IN STAINLESS STEEL CLADDING. THERMAL RATING IS 1400 MWT. PRIMARY COOLANT SYSTEM IS COMPOSED OF FOUR SODIUM LOOPS. REACTOR AND PRIMARY LOOP WOULD BE MOUNTED WITHIN A 40-FOOT DIAMETER PRIMARY-SYSTEM TANK. EXP. FACILITY SEFOR WILL BE SPONSORED BY SAEA, W. GERMANY, EURATOM, AND GE. A CRITICAL ASSEMBLY MOCKUP REACHED CRITICALITY IN ARGONNE-S ZPR-3 IN APRIL 1966.

REFERENCES

FAST OXIDE BREEDER-REACTOR PHYSICS. PART I
PARAMETRIC STUDY OF 300 MWE REACTOR CORE.
P GREEBLER, OTHERS
GEAP-3721 /DECEMBER 1961/

EXPERIMENTAL FAST OXIDE REACTOR.
MJ MC NELLY, OTHERS
POWER REACTOR EXPERIMENTS. VOL. I, P. 317-43
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA. 1962.

EXPERIMENTAL FAST CERAMIC REACTOR DESIGN. STATUS
REPORT AS OF OCTOBER 31, 1961.
KM HORST, ED.
GEAP-3885 /APRIL 1962/

DEVELOPMENT OF THE FAST CERAMIC REACTOR.
K COHEN, B WOLFE
NUCLEAR ENG. 7, 358-9 /SEPTEMBER 1962/

DEVELOPMENT OF THE FAST CERAMIC REACTOR.
K COHEN, B WOLFE
NUCLEAR NEWS 6, 11-15 /FEBRUARY 1963/

CONCEPTUAL DESIGN OF A 565 MWE FAST CERAMIC
REACTOR.
HE DODGE, OTHERS
GEAP-4226 /APRIL 1963/

THE SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR.
K COHEN, OTHERS.
EIGHTH NUCLEAR CONGRESS, ROME, ITALY.
APED-4281 /JUNE 17-20, 1963/

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SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR
DEVELOPMENT PROGRAM, FIRST QUARTERLY REPORT,
APRIL-JUNE 1964,
GEAP-4594 /JULY 1964/

PRELIMINARY SAFEGUARDS SUMMARY REPORT, PART 1,
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR
UNDATED
NP-15077 /MAY 1965/

SEFOR - A STATUS REPORT
B WOLFE, OTHERS
ANS-100 P. 247-67

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NAME/OWNER	LMFBR /LIQ, METAL FAST BREEDER REACTOR/GE	
DESIGNER	GENERAL ELECTRIC COMPANY	
PURPOSE	DESIGN STUDY FOR AEC	
TYPE	LIQUID METAL COOLED FAST BREEDER, PANCAKE CORE.	
POWER MWE(MWT)	1000	2500
CRITICAL	STUDY	
COOLANT	SODIUM	
FUEL MATERIAL	CORE, URANIUM/PLUTONIUM DIOXIDE CORED PELLETS 0.22 IN. OD., 0.01 IN. ID. BLANKET, AXIAL AND RADIAL, DEPLETED URANIUM OXIDE PELLETS 0.058 AND 0.45 IN. DIA.	
FUEL GEOMETRY	CORE, PINS 2 FT. ACT. LENGTH * 2X18 IN. UPPER AND LOWER AXIAL BLANKET RADIAL BLANKET, 30 IN. ACT. LENGTH	
FUEL CLADDING	SS CORE, 15 MILS THICK RADIAL BLANKET, 20 MILS THICK	
FUEL ENRICH.	AVERAGE 18 PER CENT	
FUEL ASSEMBLY	CORE AND AXIAL BLANKET 470 FUEL PINS 138 BERYLLIA PINS 225 ASSEMBLIES RADIAL BLANKET 208 PINS 108 ASSEMBLIES HEXAGONAL SS FUEL CHANNELS, CORE IS 2 FT. HIGH AND 11.65 FT, DIA.	
FUEL CHARGE	2304 KG, FISSILE METAL, BLANKET 58 KG	
SPECIFIC POWER	900 KW/KG PLUTONIUM	
BURNUP(REFUEL)	100,000 MWD/T	
CONTROL	RODS, BORON CARBIDE, SODIUM FOLLOWER	
COOLANT TEMP.	INLET 800 F	OUTLET 1100 F
COOLANT PRESS.	INLET 50 PSIA	OUTLET 25 PSIA

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REACTOR VESSEL PRIMARY TANK AND REACTOR VESSEL OF SS

CONTAINMENT LEAK-TIGHT BUILDING, FILLED BELOW OPERATING
FLOOR WITH INERT GAS.

REFERENCES LIQUID METAL FAST BREEDER REACTOR DESIGN STUDY
 1000 MWE URANIUM/PLUTONIUM DIOXIDE FUELED PLANT,
 VOL. 1-2,
 MJ MC NELLY /GENERAL ELECTRIC CO., APED/
 GEAP-4418 /VOL. 1 AND VOL. 2/ /JAN. 1963/

AN EVALUATION OF FOUR DESIGN STUDIES OF A 1000 MWE
CERAMIC FUELED FAST BREEDER REACTOR.
REACTOR ENG. DIV., CHICAGO OPERATIONS OFFICE
C00-279 /DEC. 1, 1964/

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NAME/OWNER MCR /MILITARY COMPACT REACTOR//DOD-ARMY

DESIGNER GENERAL MOTORS, NUCLEAR DEVELOPMENT CORP. AMERICA

PURPOSE PROTOTYPE DEVELOPMENT. MOBILE REACTOR, EDS /ENERGY DEPOT SYSTEM/

TYPE LIQUID METAL COOLED, FAST REACTOR, HIGH TEMPERATURE.

POWER MWE(MWT) 2-3

CRITICAL DEVELOPMENT, COMPONENT TESTING AND FUEL DEVELOPMENT.

REMARKS
 HIGHLY MOBILE NUCLEAR ELECTRIC GENERATING PLANT. THE LIQUID METAL COOLANT TRANSFERS ITS HEAT THROUGH TWO EXCHANGERS TO COMPRESSED AIR. HEATED AIR FROM EACH HEAT EXCHANGER RUNS AN OPEN BRAYTON-CYCLE GAS TURBINE. TURBINES ARE MODIFIED T-56 ENGINES. THE PLANT IS COMPOSED OF FIVE SEPARABLE PACKAGES WHICH CAN BE CARRIED CROSS COUNTRY IN FOUR TRAILERS AND 1 TRUCK.
 PACKAGE I. REMOVABLE SHIELD FOR REACTOR OPERATION.
 PACKAGE II. REACTOR AND SHUT-DOWN SHIELDING, PRIMARY COOLANT LOOP, SELF CONTAINED AFTERHEAT REMOVAL SYSTEM.
 PACKAGE III. ENGINES AND ALTERNATORS
 PACKAGE IV. SWITCHGEAR AND ELECTRICAL PROTECTIVE EQUIP.
 PACKAGE V. CONTROL CONSOLE PANEL, ASSOCIATED COMPUTER EQUIPMENT.
 THE EDS CONCEPT CALLS FOR THE USE OF A HIGHLY MOBILE REACTOR TO PRODUCE FUEL FROM AIR AND WATER FOR ARMY FIELD FORCES.

REFERENCES NUCLEONICS WEEK SEPT. 24, 1964 P. 2.

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NAME/OWNER LAMPRE /LOS ALAMOS MOLTEN PLUTONIUM REACTOR//AEC
 DESIGNER LOS ALAMOS SCIENTIFIC LABORATORY
 OPERATOR LOS ALAMOS SCIENTIFIC LABORATORY
 LOCATION LOS ALAMOS, N. M.
 PURPOSE POWER EXPERIMENT
 TYPE LIQUID METAL COOLED, FAST REACTOR, LIQ. METAL FUEL
 CRITICAL 1961
 COOLANT SODIUM
 FUEL MATERIAL PLUTONIUM-IRON ALLOY /MOLTEN/ /SEE REMARKS/
 FUEL GEOMETRY MOLTEN ALLOY
 FUEL CLADDING TANTALUM-TUNGSTEN ALLOY CAPSULES
 0.376 IN. ID. 8 IN. LONG
 FUEL ENRICH. 90 PER CENT
 FUEL ASSEMBLY CORE CONSISTS OF FOOT-LONG TANTALUM-TUNGSTEN
 THIMBLES CONTAINING THE PLUTONIUM-IRON FUEL,
 PLACED IN THE SODIUM COOLANT. THERE ARE 199
 CAPSULES, SOME OCCUPIED BY UNFUELED REFLECTOR PINS
 SPECIFIC POWER 40 W/G FUEL
 COOLANT TEMP. INLET 450 C OUTLET 563 C
 REACTOR VESSEL INNER CONTAINMENT VESSEL OF SS, OUTER VESSEL SS
 REMARKS A NEW FUEL ALLOY UNDER DEVELOPMENT WILL BE A
 TERNARY PLUTONIUM-COBALT-CESIUM ALLOY IN WHICH THE
 PLUTONIUM CONTENT CAN BE VARIED OVER A WIDE RANGE.
 CORE 3 WILL CONTAIN SOME OF THIS FUEL, LOADING IN
 1964. A PROJECT ORIGINALLY DESIGNATED AS
 LAMPRE-II, NOW KNOWN AS FRCTF /FAST REACTOR CORE
 TEST FACILITY/ IS UNDER WAY. IT IS A SODIUM COOLED
 SYSTEM FOR TESTING ADVANCED CORE CONCEPTS. AIM
 IS 300 W/G PLUTONIUM. TARGET 1967.
 REFERENCES LAMPRE, A MOLTEN PLUTONIUM FUELED REACTOR CONCEPT,
 RM KIEHN, OTHERS
 LA-2112 /JANUARY 1957/

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LIQUID METAL REACTORS, DOMESTIC

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LOS ALAMOS MOLTEN PLUTONIUM REACTOR EXPERIMENT.
/LAMPRE/ HAZARD REPORT.
EO SWICKARD
LA-2327 /JUNE 1959/

JANUARY 1967

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NAME/OWNER FRCTF /FAST REACTOR CORE TEST FACILITY//AEC

DESIGNER LOS ALAMOS SCIENTIFIC LABORATORY

OPERATOR LOS ALAMOS SCIENTIFIC LABORATORY

LOCATION LOS ALAMOS, N. M.

PURPOSE EVALUATION OF FAST REACTOR CORE CONCEPTS. TEST BED

TYPE LIQUID METAL COOLED, ADVANCED CORE TEST FACILITY,
FAST REACTOR.

POWER MWE(MWT) 15

COOLANT SODIUM

FUEL MATERIAL PLUTONIUM-IRON /MOLTEN/,
BLANKET URANIUM-MOLYBDENUM

FUEL GEOMETRY MOLTEN ALLOY

FUEL ASSEMBLY CAPSULES /SEE LAMPRE/ CONTAINING MOLTEN FUEL.
ONE CORE CONCEPT USES SPIRALS OF FLATTENED TUBING
TO CONTAIN THE MOLTEN FUEL.

SPECIFIC POWER 517 W/G FUEL

COOLANT TEMP. 650 C MAX.

REACTOR VESSEL CIRCULAR SS VESSEL, 25 FT. DEEP. COAXIAL INNER
SLEEVES. UPPER 4 FT. DIA. LOWER 7 FT. DIA.
DOUBLE-WALL.

CONTAINMENT CONCRETE PITS. CONVENTIONAL BUILDING.

REMARKS CONSTRUCTION

REFERENCES A PRELIMINARY STUDY OF A FAST REACTOR CORE TEST
FACILITY.
DB HALL, OTHERS
LA-2332 /AUGUST 1959/

JANUARY 1967

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LIQUID METAL REACTORS. DOMESTIC

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NAME/OWNER	DCR/DIRECT CONTACT REACTOR//LASL
DESIGNER	LOS ALAMOS SCIENTIFIC LABORATORY
PURPOSE	FAST BREEDER CONCEPT, STUDY
TYPE	LIQUID METAL COOLED, FAST BREEDER.
POWER MWE(MWT)	227
CRITICAL	DESIGN STUDY
COOLANT	SODIUM
FUEL MATERIAL	PLUTONIUM-COBALT-IRON ALLOY /MOLTEN/ URANIUM DIOXIDE-SODIUM PASTE BLANKET
FUEL GEOMETRY	MOLTEN ALLOY, PASTE BLANKET
FUEL CLADDING	TANTALUM-TUNGSTEN ALLOY STRUCTURAL MATERIAL
FUEL ASSEMBLY	VESSEL IS FILLED WITH THE LIQUID FUEL. AN EXTERNAL JET OF LIQUID SODIUM CIRCULATES THE FUEL AND SEPARATES THE LIQUIDS CENTRIFUGALLY. AFTER SEPARATION FUEL RETURNS TO THE CORE. CORE DIAMETER IS 70 CM.
FUEL CHARGE	350 LITERS OF FUEL /1 KG PLUTONIUM/LITER/
SPECIFIC POWER	0.65 KW/G PLUTONIUM /EXCLUDING BLANKET/
COOLANT TEMP.	OUTLET 850 C
REACTOR VESSEL	STRUCTURELESS VESSEL
REMARKS	THE SODIUM COOLANT, IMMISCIBLE WITH THE MOLTEN FUEL ALLOY, IS IN DIRECT CONTACT WITH IT. SEPARATION IS DONE CENTRIFUGALLY BY THE ENERGY FROM AN EXTERNAL JET OF SODIUM.
REFERENCES	MOBILE FUEL PLUTONIUM BREEDERS A STUDY OF ECONOMIC POTENTIAL, RP HAMMOND, OTHERS LA-2644 /NOV. 30, 1961/ DIRECT CONTACT CORE SYSTEMS. RP HAMMOND, JR HUMPHREYS JR. NUCLEAR SCIENCE AND ENGINEERING 18, 421-425 /APRIL 1964/

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NAME/OWNER	FAST OXIDE REACTOR STUDY/LASL	
DESIGNER	LOS ALAMOS SCIENTIFIC LABORATORY	
PURPOSE	WATER DESALINATION	
TYPE	LIQUID METAL COOLED FAST BREEDER	
POWER MWE(MWT)	25000	
CRITICAL	STUDY	
COOLANT	SODIUM	
FUEL MATERIAL	URANIUM/PLUTONIUM DIOXIDE PELLETS 0.260 IN. DIA. URANIUM DIOXIDE AXIAL AND RADIAL BLANKET	
FUEL GEOMETRY	RODS, ACT, LENGTH 4 FT. + 2X3 FT. UPPER AND LOWER AXIAL BLANKET	
FUEL CLADDING	SS 0.020 IN. THICK	
FUEL ENRICH.	15 PER CENT	
FUEL ASSEMBLY	400 RODS/ASSEMBLY 1016 ASSEMBLIES/CORE	
SPECIFIC POWER	1.1 MW/KG PLUTONIUM	
BURNUP(REFUEL)	100,000 MWD/MT	BATCH, 3 MONTHS
COOLANT TEMP.	INLET 593 F	
REMARKS	THE ENERGY IS USED ENTIRELY FOR THE PRODUCTION OF DISTILLED WATER. WATER CONVERSION PLANT IS A MULTISTAGE FLASH EVAPORATION UNIT CONSISTING OF 30 STAGES,	
REFERENCES	A PRELIMINARY EVALUATION OF FAST OXIDE BREEDERS FOR SEA-WATER CONVERSION, A SESONSKE, RP HAMMOND LA-2733 /AUG. 1962/	

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LIQUID METAL REACTORS. DOMESTIC

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NAME/OWNER	PWAR-6 /PRATT + WHITNEY AIRCRAFT REACTOR-6//PWAC	
DESIGNER	PRATT AND WHITNEY AIRCRAFT	
PURPOSE	NUCLEAR AIRCRAFT HEAT SOURCE	
TYPE	LIQUID METAL COOLED, CIRCULATING FUEL	
POWER MWE(MWT)	180	
CRITICAL	CONCEPTUAL DESIGN STUDY	
COOLANT	SODIUM-POTASSIUM NAK	
MODERATOR	BERYLLIUM REFLECTOR-MODERATOR. HOLLOW SPHERE SURROUNDING CORE.	
FUEL MATERIAL	FLUORIDE SALTS /SODIUM, ZIRCONIUM AND URANIUM/	
FUEL CLADDING	INCONEL MATERIAL OF CONSTRUCTION	
FUEL ASSEMBLY	FUEL FLOWS OUTSIDE THE HEAT EXCHANGER TUBES COUNTER CURRENT TO NAK FLOWING INSIDE THE TUBES.	
NEUTRON FLUX	THERMAL AVE. 1×10^{14} FAST AVE. 3×10^{14}	
CONTROL	CONTROL ROD	
COOLANT TEMP.	INLET 200 F	OUTLET 600 F
REACTOR VESSEL	HASTELLOY-X PRESSURE SHELL 70 IN. DIA./1 IN. THICK. INNER SHELLS CONTAINING BORON-10, AND AN INCONEL SHELL JUST INSIDE THE PRESSURE SHELL.	
REMARKS	EVOLUTION OF ORNL FIREBALL REACTOR CONCEPT /ART DESIGN MODIFICATION/.	
REFERENCES	CORE-MODERATED CIRCULATING FUEL REACTOR STUDY. PRATT + WHITNEY AIRCRAFT, DIV. UNITED AIRCRAFT CORP. PWAC-186 /JULY 15, 1957/ THE P + W CIRCULATING FUEL REFLECTOR-MODERATED REACTOR. CC BIGELOW, ME GREENSTREET PWAC-189 /VOL. 1/ /NOVEMBER 15, 1957/ VOLUME 2. APPENDIX A. DESIGN SPECIFICATIONS AND REFERENCE INFORMATION FOR THE PWAR-6. FLYING TEST	

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BED APPLICATION.
CC BIGELOW, ME GREENSTREET, COMPS.
PWAC-189 /VOL. 2/ /NOVEMBER 15, 1957/

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LIQUID METAL REACTORS, DOMESTIC

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NAME/OWNER LCRE /LITHIUM COOLED REACTOR EXP. / PWAC

DESIGNER PRATT AND WHITNEY AIRCRAFT

OPERATOR PRATT AND WHITNEY AIRCRAFT

LOCATION CONNECTICUT AIRCRAFT NUCLEAR ENG. LAB, /CANEL/
10 MWT EXPERIMENT
SEE REMARKS

TYPE LIQUID METAL COOLED, INDIRECT CYCLE

COOLANT LITHIUM /POTASSIUM INTERMEDIATE LOOP/

MODERATOR BERYLLIUM OXIDE

FUEL MATERIAL URANIUM/BERYLLIUM OXIDE

REMARKS CANEL PROGRAM WAS CANCELED IN THE FINAL DESIGN
STAGE OF A 10 MWT EXPERIMENT. AEC WILL PROCEED
DIRECTLY TO THE DESIGN AND DEVELOPMENT OF A
SNAP-50 REACTOR PROTOTYPE UNDER THE SNAP-50/SPUR
PROGRAM FOR A LIQUID METAL COOLED FAST REACTOR
SYSTEM /AEC-NASA-DOD/

REFERENCES DESIGN CRITERIA FOR LITHIUM-COOLED REACTOR
VAPOR TURBINE
DT HEDDEN
CNLM-4043 /REV. A/ /SEPTEMBER 4, 1962/

 PRELIMINARY SAFETY ANALYSIS REPORT FOR THE
LITHIUM COOLED REACTOR EXPERIMENT /LCRE/
CC BIGELOW, P COLE, OTHERS
PWAC-370 /SUPPL. 1/ /SEPTEMBER 29, 1962/

JANUARY 1967

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LIQUID METAL REACTORS, DOMESTIC

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NAME/OWNER FAST BREEDER STUDY/WESTINGHOUSE

DESIGNER WESTINGHOUSE ELECTRIC CORPORATION

TYPE LIQUID METAL COOLED FAST BREEDER. MODULAR DESIGN.

POWER MWE(MWT) 1000 2170

CRITICAL STUDY, R+D FOR 1970 CONSTRUCTION.

COOLANT SODIUM

FUEL MATERIAL URANIUM-PLUTONIUM CARBIDE PELLETS 0.268 IN. DIA,
AXIAL BLANKET URANIUM CARBIDE
RADIAL BLANKET URANIUM DIOXIDE

FUEL GEOMETRY RODS

FUEL CLADDING SS 0.020 IN. THICK, SODIUM BOND

FUEL ENRICH. AVE. 15.7 PER CENT
RADIAL BLANKET DEPLETED URANIUM

FUEL ASSEMBLY 120-ROD ASSEMBLY
36 ASSEMBLIES/MODULE
7 MODULES
BLANKET 91-ROD ASSEMBLY
51 ASSEMBLIES/MODULE

SPECIFIC POWER 520 KW/KG FISSILE

BURNUP(REFUEL) 100 MWD/KG URANIUM + PLUTONIUM

CONTROL RODS, BORON CARBIDE, FOLLOWER VOIDS + SODIUM

COOLANT TEMP. INLET 977 F OUTLET 1200 F

REACTOR VESSEL CORE MODULES ARE HEXAGONAL CANS COMPOSED OF CORE,
BLANKET, CONTROL, AND GRAPHITE BARRIER REGIONS,
REACTOR VESSEL IS 18 FT. DIA./36 FT. HIGH

REMARKS THE REACTOR CONSISTS OF 7 IDENTICAL MODULES, EACH
COMPOSED OF A CORE REGION, A BLANKET REGION,
CONTROL, AND GRAPHITE BARRIER. ACTIVE CORE IN
EACH MODULE IS A RIGHT CYLINDER APPROXIMATELY
6.25 FT. HIGH/ 2.75 FT. DIA. SURROUNDED BY APPROX.
1 FT. OF BLANKET ON ALL SIDES. SURROUNDING
BLANKET REGION, ONLY ALONG VERTICAL SIDES, IS A
GRAPHITE BARRIER. FUEL, BLANKET, AND GRAPHITE
SUBASSEMBLIES ARE EXTERNALLY IDENTICAL. HEXAGONAL

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CAN ABOUT 5 IN. ACROSS FLATS AND 11 FT. LONG, INCLUDING END FITTINGS. SODIUM COOLANT ENTERS REACTOR VESSEL FROM ABOVE TOP OF CORE AND FLOWS DOWN ANNULUS WITHIN VESSEL, THROUGH ORIFICES INTO TWO PLENUM REGIONS IN THE BOTTOM OF THE VESSEL. ONE PLENUM FEEDS TO CORE REGIONS, THE OTHER, LOWER PRESSURE, THE BLANKET REGIONS. WESTINGHOUSE WILL DEVELOP AND START CONSTRUCTION OF A FAST BREEDER POWER PLANT BY 1970, THE COMPANY WILL ASK INDUSTRY AND GOVERNMENT ASSISTANCE. OAK RIDGE HAS ADAPTED THE CONCEPT TO A FAST REACTOR FOR POWER AND/OR DESALINATION.
SEE FD29

REFERENCES

LIQUID METAL FAST BREEDER REACTOR DESIGN STUDY,
FINAL REPORT,
RB STECH, COMP,
WESTINGHOUSE ELECTRIC CORP. ATOMIC POWER DIV,
WCAP 3251-1 /JANUARY 1964/

AN EVALUATION OF FOUR DESIGN STUDIES OF A 1000 MWE
CERAMIC FUELED FAST BREEDER REACTOR
REACTOR ENG, DIV., CHICAGO OPERATIONS OFFICE
C00-279 /DEC. 1, 1964/

CONCEPTUAL DESIGN AND PRELIMINARY ACCIDENT
ANALYSIS OF A SODIUM-COOLED, CARBIDE-FUELED,
LARGE MODULAR FAST REACTOR.
JH WRIGHT, OTHERS
ANL-7120, P.205-29 /1966/

JANUARY 1967

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LIQUID METAL REACTORS. DOMESTIC

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NAME/OWNER LIQUID METAL COOLED FAST BREEDER/ORNL

DESIGNER OAK RIDGE NATIONAL LABORATORY

PURPOSE DESALINATION AND/OR POWER
 APPLICATIONS CONSIDERED ARE CENTRAL STATION
 POWER, DUAL PURPOSE SELF-CONTAINED STATION,
 AND PROCESS HEAT PLANT.

TYPE LIQUID METAL COOLED FAST BREEDER,
 LOW TEMPERATURE, MODULAR CONCEPT

POWER MWE(MWT) 420 3500
 DUAL PURPOSE

CRITICAL REFERENCE DESIGN

COOLANT SODIUM

FUEL MATERIAL CORE, URANIUM/PLUTONIUM DIOXIDE, VIBRATORY COMPACT
 AXIAL BLANKET, URANIUM DIOXIDE
 RADIAL BLANKET, URANIUM METAL

FUEL GEOMETRY CORE, PIN 0.246 IN. OD., 9 FT. ACT. LENGTH
 PLUS 2X1 FT. AXIAL BLANKET
 RADIAL BLANKET, ROD 0.731 IN. OD.

FUEL CLADDING SS
 CORE 0.012 IN. THICK
 RADIAL BLANKET 0.020 IN. THICK

FUEL ASSEMBLY 91-PIN BUNDLE, HEXAGONAL CONTAINER, SPACING BY
 GRID-TYPE SPACERS FOR CORE MODULES AND BY
 HELICAL WIRE WRAP FOR RADIAL BLANKET RODS.
 CORE MODULE SEPARATED BY 5 ROWS OF RADIAL
 BLANKET ASSEMBLIES
 12 REACTOR MODULES, EACH SURROUNDED BY RADIAL
 BLANKET AND CONTAINING 4 CONTROL RODS.
 60 FUEL POSITIONS PER MODULE.

FUEL CHARGE CORE, 31,457 KG, URANIUM/PLUTONIUM OXIDE
 AXIAL BLANKET, 12,071 KG, URANIUM OXIDE
 RADIAL BLANKET, 226,123 KG, URANIUM

SPECIFIC POWER CORE, 88.7 KW/KG
 BLANKET, 2.96 KW/KG

BURNUP(REFUEL) CORE, 100,000 MWD/T SHUT-DOWN
 BLANKET, 41,000 MWD/T 6 MO.=1 YEAR

CONTROL ABSORBER RODS, 4 PER MODULE

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COOLANT TEMP. INLET 500 F OUTLET 800 F

REACTOR VESSEL MODULE CONTAINER OF SS, BIOLOGICAL SHIELD.
GRID STRUCTURE LOCATES AND SUPPORTS THE FUEL
ASSEMBLIES.

CONTAINMENT STEEL-LINED CELL BELOW OPERATING FLOOR OF MILL-
TYPE REACTOR BUILDING.

REMARKS DESIGN IS AN ADAPTATION OF THE WESTINGHOUSE
MODULAR CONCEPT FOR A HIGH TEMPERATURE FAST
BREEDER.
SEE FD28
CORE STRUCTURAL MATERIAL IS STAINLESS STEEL.
COOLANT FLOW IS UPWARD THROUGH REACTOR,
THE REFERENCE DESIGN ABSTRACTED REFERS TO A
DUAL PURPOSE SYSTEM.

REFERENCES A 3500 MWT LOW-TEMPERATURE SODIUM-COOLED FAST
BREEDER REACTOR FOR DESALINATION
RC OLSON, OTHERS
ORNL-TM-1143 /JUNE 10, 1965/

COST STUDY OF A LARGE SODIUM-COOLED FAST BREEDER
REACTOR FOR A SEA-WATER DESALINATION PLANT.
WR GALL
ORNL-TM-784 /MARCH 1964/

JANUARY 1967

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LIQUID METAL REACTORS, DOMESTIC

FD30

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NAME/OWNER FFTF /FAST FLUX TEST FACILITY/AEC

DESIGNER PACIFIC NORTHWEST LAB., BATTELLE MEMORIAL INST.

TYPE LIQUID METAL COOLED FAST TEST REACTOR
 SKEWED-TUBE CORE

POWER MWE(MWT) 400 FIRST OPERATION 300 MWT

CRITICAL CONCEPTUAL DESIGN, REFERENCE DESIGN TARGET 1972-3.
 PROTOTYPE OPERATION TARGET 1976

COOLANT SODIUM

FUEL MATERIAL DRIVER FUEL, PLUTONIUM DIOXIDE-SS CERMET

FUEL GEOMETRY PINS

FUEL CLADDING SS

FUEL ASSEMBLY DRIVER FUEL ELEMENTS, 300 MWT OPERATION
 73-TUBE CORE, 45 DRIVER ELEMENTS
 6 SAFETY AND SHIM RODS
 6 OPEN LOOPS
 4 CLOSED LOOPS
 12 NON-FUEL TUBES /EDGE/

NEUTRON FLUX 300 MWT OPERATION, 10 E+16 PEAK

COOLANT TEMP. INLET 500 F OUTLET 800 F

REMARKS INTEGRATED FAST-NEUTRON IRRADIATION-EXAMINATION
 FACILITY WITH A BROAD RANGE OF IRRADIATION TEST
 ENVIRONMENTS, POST-IRRADIATION EXAMINATION FOR
 FAST REACTOR FUELS AND MATERIALS.
 CONSTRUCTION IS NOT TO BEGIN BEFORE FISCAL 1968.
 FOR THE FINAL CONCEPTUAL DESIGN BATTELLE-NORTHWEST
 WILL COLLABORATE WITH ARGONNE AND WITH AI, GE,
 PHILLIPS PETROLEUM, AND WESTINGHOUSE.

REFERENCES THE FAST FLUX TEST FACILITY DESIGN CONCEPT,
 ER ASTLEY, LM FINCH, RJ HENNIG
 ANS TRANS. 8, 607 /NOV. 1965/

 PHYSICS ASPECTS OF THE FAST FLUX TEST REACTOR
 WW LITTLE, PL HOFMANN
 ANS TRANS. 8, 608 /NOV. 1965/

 FFTF DRIVER FUEL, PLUTONIUM DIOXIDE-STAINLESS
 STEEL CERMET.

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WJ BAILEY, OTHERS
BNWL-SA-251 /NOV. 3, 1965/

FAST FLUX TEST FACILITY
A AMOROSI, OTHERS
APDA-178 P. 67-70

JANUARY 1967

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LIQUID METAL REACTORS. DOMESTIC

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NAME/OWNER	MODULAR FLUX TRAP REACTOR	
DESIGNER	ATOMICS INTERNATIONAL	
PURPOSE	POWER	
TYPE	LIQUID METAL COOLED FAST BREEDER	
POWER MWE(MWT)	1000	2500
CRITICAL	FEASIBILITY STUDY	
COOLANT	SODIUM	
FUEL MATERIAL	URANIUM-PLUTONIUM OXIDE PELLETS OR URANIUM-PLUTONIUM CARBIDE, CORED, BLANKET DEPLETED URANIUM DIOXIDE	
FUEL GEOMETRY	ROD	
FUEL CLADDING	STAINLESS STEEL	
FUEL ENRICH.	BLANKET DEPLETED URANIUM	
FUEL ASSEMBLY	BUNDLE CORE AXIAL BLANKET RADIAL BLANKET	
REMARKS	REACTOR IS A VERSION OF THE SODIUM COOLED COUPLED REACTOR SSCR.	
REFERENCES	FEASIBILITY STUDY OF A 1000 MWE SODIUM COOLED FAST REACTOR DT EGGEN, HA MOREWITZ NAA-SR-11378 /1965/ VOL. 3, METHODS DEVELOPMENT	

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LIQUID METAL REACTORS, DOMESTIC

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NAME/OWNER	METAL FUELED FAST BREEDER
DESIGNER	ARGONNE NATIONAL LAB.
PURPOSE	POWER
TYPE	LIQUID METAL COOLED FAST BREEDER. MODULAR DESIGN
POWER MWE(MWT)	1000 2510
CRITICAL	PRELIMINARY DESIGN
COOLANT	SODIUM
MODERATOR	BERYLLIUM, SS REFLECTOR
FUEL MATERIAL	URANIUM-PLUTONIUM-TITANIUM ALLOY. BLANKET URANIUM METAL
FUEL GEOMETRY	PINS
FUEL CLADDING	VANADIUM-TITANIUM ALLOY TUBES
FUEL ASSEMBLY	331-PIN BUNDLE IN HEXAGONAL TUBE OF 17-4 PH STEEL. 61 SUBASSEMBLIES PER MODULE 6 MODULES
FUEL CHARGE	17.94 METRIC TONS URANIUM PLUS PLUTONIUM
SPECIFIC POWER AVERAGE	860 KG/KW PLUTONIUM
CONTROL	BORON CARBIDE RODS IN CENTRAL PART OF MODULE
COOLANT TEMP.	INLET 720 F OUTLET 1000 F
REACTOR VESSEL	TANK, 20 FT. DIA./30 FT. HIGH
REMARKS	AXIAL BLANKETS ARE INTEGRAL WITH THE CORE CLADDING THE RADIAL BLANKET HAS TWO ZONES, WITH SMALLER DIAMETER ELEMENTS IN THE INNER ZONE, WHICH ALSO CONTAINS SOME BERYLLIUM. INNER SURFACE OF INNER BLANKET IS FORMED BY TRIANGULAR PIECES OF BERYLLIUM, AS IS THE OUTER SURFACE OF THE CORE SUBASSEMBLY. THE DESIGN INCLUDES ON-SITE FUEL CYCLE FACILITY.
REFERENCES	1000 MWE METAL-FUELED FAST BREEDER REACTOR, LE LINK, OTHERS ANL-7001 /JUNE 1966/

LIQUID METAL COOLED REACTORS

FOREIGN

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LIQUID METAL REACTORS, FOREIGN

FF01

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NAME/OWNER	RAPSODIE/CEA, FRANCE
DESIGNER	CEA, FRANCE
OPERATOR	CEA, FRANCE
LOCATION	CADARACHE RESEARCH CENTER, FRANCE
PURPOSE	POWER EXPERIMENT
TYPE	LIQUID METAL COOLED FAST BREEDER
POWER MWE(MWT)	10-20
CRITICAL	CONSTRUCTION, TARGET 1966
COOLANT	SODIUM, TWO PRIMARY SYSTEMS, CENTRAL AREA HIGH PRESSURE AND PERIPHERAL AREA LOW PRESSURE.
FUEL MATERIAL	CORE, URANIUM/PLUTONIUM DIOXIDE PELLETS 5.8 MM. DIA., 11.5 MM. LONG BLANKET, URANIUM DIOXIDE
FUEL GEOMETRY	PENCILS, PELLET STACK 340 MM. HIGH
FUEL CLADDING	SS 0.45 MM. WALL THICKNESS
FUEL ENRICH.	PLUTONIUM-240 AND 241 10.2 PER CENT 60 PER CENT U-235 BLANKET, DEPLETED URANIUM
FUEL ASSEMBLY	37 PENCILS/ASSEMBLY IN HEXAGONAL CASING, CORE PENCILS INCLUDE AXIAL BLANKET, 53 ASSEMBLIES + 500 PERIPHERAL FERTILE ASSEMBLIES AXIAL BLANKET 14 PINS/ASSEMBLY RADIAL BLANKET 7 PINS/ASSEMBLY
FUEL CHARGE	8 TONS URANIUM DIOXIDE
SPECIFIC POWER	1750 W/CC. /1.52 KW/CC. FUEL/
BURNUP(REFUEL)	30,000 MWD/TON FUEL
NEUTRON FLUX	HIGH 2×10^{15}
CONTROL	RODS IN PERIPHERY OF CORE, BORON CARBIDE
COOLANT TEMP.	INLET 450 C OUTLET 540 C
REACTOR VESSEL	SS SHELL 7 FT. 8 IN. DIA., 0.6 IN. THICK.

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FF01

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SAFETY VESSEL OF ORDINARY STEEL.

CONTAINMENT

AIRTIGHT BUILDING HOUSES REACTOR AND THE TWO SODIUM SYSTEMS. FLAT-BOTTOMED CYLINDER WITH HEMISPHERICAL DOME, ALL STEEL, INSIDE A LEAK-PROOF CONCRETE BUILDING

REMARKS

PARTICIPATION IN THE U.S.-EURATOM PLUTONIUM RECYCLE PROGRAM, WITH THE OBJECTIVE OF CONSTRUCTING LARGE-SCALE CRITICAL ASSEMBLIES, DESIGN OF 100 MWE REACTORS, AND STUDIES LEADING TO THE DESIGN OF FAST NEUTRON REACTORS USING THE URANIUM-THORIUM FUEL CYCLE. IN A FULL-SCALE REACTOR WITH A LARGER CORE NATURAL OR DEPLETED URANIUM OXIDE WOULD BE USED WITH PLUTONIUM OXIDE FOR THE CORE ELEMENTS. OPTIMIZATION STUDIES FOR A 1000 MWE REFERENCE DESIGN HAVE BEEN PERFORMED. FOR EXPERIMENTAL STUDY OF FAST PLUTONIUM SYSTEMS, MASURCA /O-POWER/ AND HARMONIE /FAST SOURCE REACTOR/ ARE UNDER CONSTRUCTION AT CADARACHE. NEXT STEP IN THE FRENCH PROGRAM WILL BE CONSTRUCTION OF AN 80 MWE PROTOTYPE. GOAL IS A 1000 MWE FAST BREEDER.
SEE PHENIX, FF12

REFERENCES

RAPSODIE,
G VENDRYES
ENERGIE NUCLEAIRE 3, 25-46 /JANUARY-FEBRUARY 1961/

THE FAST REACTOR RAPSODIE.
CP ZALESKI, L VAUTREY
POWER REACTOR EXPERIMENTS, VOL. 1, P. 365-8
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1962,
/ABSTRACT ONLY/.

THE RAPSODIE PROJECT.
JR LEDUC
TID-7623 /P. 168-70/ /1962/

THE FAST BREEDER REACTOR RAPSODIE, VOLUME 1, TEST
VOLUME 2, FIGURES /IN FRENCH/.
CP ZALESKI, L VAUTREY
CEA-2193 /1962/

RAPSODIE--A VITAL FAST REACTOR PROJECT,
R WUSTNER
NUCLEAR ENG. 8, 316-21 /SEPTEMBER 1963/

RAPSODIE
G VENDRYES

JANUARY 1967

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LIQUID METAL REACTORS, FOREIGN

FF01

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3RD UN. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC
ENERGY, GENEVA, 1964
A/CONF. 28/P/42

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LIQUID METAL REACTORS, FOREIGN

FF02

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NAME/OWNER	RAPTUS/RAPID THORIUM-URANIUM-SODIUM/CNEN, ITALY
DESIGNER	CNEN, ITALY
PURPOSE	DEVELOPMENT
TYPE	LIQUID METAL COOLED, FAST REACTOR, MERCURY BINARY CYCLE.
POWER MWE(MWT)	60
CRITICAL	DESIGN, DEVELOPMENT
COOLANT	SODIUM
FUEL MATERIAL	THORIUM/URANIUM-233 OXIDES AS SLURRY IN SODIUM, PASTE-TYPE FUEL
FUEL GEOMETRY	SLURRY /PASTE/
REACTOR VESSEL	CONTAINING SHELL FOR FUEL, SODIUM FLOWS THROUGH THE TUBES OF SUBASSEMBLIES RESEMBLING TUBE-TYPE HEAT EXCHANGERS,
REMARKS	<p>LONG TERM DEVELOPMENT PROJECT AIMED AT EXPLORING THE THORIUM-URANIUM FUEL CYCLE. HIGH TEMPERATURE SODIUM HEAT EXCHANGE STUDIES ARE IN PROGRESS. CONCEPT PROPOSES A SLURRY OF THORIUM/URANIUM-223 OXIDES SURROUNDING AN ARRAY OF TUBES CONTAINING LIQUID SODIUM. ITALY IS ALSO PLANNING TO STUDY A FAST PLUTONIUM BREEDER USING CERAMIC FUEL. AIM OF THE PROJECT IS TO DEVELOP A PASTE-TYPE FUEL CONSISTING OF THORIUM/URANIUM-233 OXIDES IN SODIUM. PROGRAM PROPOSES CONSTRUCTION OF A 60 MWE PROTOTYPE PLANT COOLED BY SODIUM, THE DESIGN TO INCLUDE A TARGET COMMERCIAL-SIZE PLANT. FEATURES OF THE TARGET PLANT WILL BE OXIDE FUELS, INTEGRAL REPROCESSING, AND A BINARY MERCURY-STEAM POWER SYSTEM. THE MERCURY SYSTEM, AS A SECONDARY COOLANT, WOULD OPERATE A MERCURY-VAPOR GENERATOR, THE OTHER GENERATOR TURNED BY STEAM GENERATED BY THE CONDENSING MERCURY VAPOR. AC MAY BE ENGAGED AS NUCLEAR SYSTEM DESIGNER-SUPPLIER. CNEN /ITALY/ AND EURATOM HAVE REACHED A JOINT AGREEMENT FOR A 3-1/2-YEAR PERIOD OF ASSOCIATION COVERING PRELIMINARY DEVELOPMENT OF THE RAPTUS CONCEPT. A NUCLEAR PHYSICS PROGRAM IS REPORTEDLY IN PROGRESS.</p>
REFERENCES	CNEN PROGRAM FOR A MERCURY BINARY CYCLE POWER PLANT,

JANUARY 1967

BNWL=326

LIQUID METAL REACTORS. FOREIGN

FF02

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A FORCELLA
PREPRINT PAPER NO. 14. ENGINEERS JOINT COUNCIL,
N. Y. 1962.

FAST REACTORS - A WORLD SURVEY,
NUCLEAR POWER 17. 42-49 /DECEMBER 1962/

FORUM MEMO JULY 1963 P. 18-19
NEWS RELEASE.

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NAME/OWNER	DUNREAY /DOUNREAY FAST REACTOR/ AEA, UNITED KINGDOM	
DESIGNER	AEA, UNITED KINGDOM	
OPERATOR	AEA, UNITED KINGDOM	
LOCATION	DOUNREAY, CAITHNESS, SCOTLAND	
PURPOSE	POWER EXPERIMENT	
TYPE	LIQUID METAL COOLED FAST BREEDER	
POWER MWE(MWT)	15	50-60
CRITICAL	NOV, 1959. REFUELED 1964	
COOLANT	SODIUM-POTASSIUM NAK. LATER SODIUM.	
FUEL MATERIAL	URANIUM-MOLYBDENUM ALLOY NATURAL URANIUM BLANKET	
FUEL GEOMETRY	HOLLOW RODS. BLANKET SOLID RODS.	
FUEL CLADDING	NIOBIUM /OUTER/ AND VANADIUM /INNER/, BLANKET SS.	
FUEL ENRICH.	40 PER CENT U-235	
FUEL ASSEMBLY	ANNULAR TUBE 525 MM. LONG/18.75 MM. DIA. UPPER PART OF ELEMENT-THE BREEDER END-PIECE- IS 150 MM. LENGTH OF NATURAL URANIUM. BREEDER RODS SURROUND THE CORE. SEE REMARKS. 345 ELEMENTS/CORE 1872 BREEDER ELEMENTS	
SPECIFIC POWER	286 KW/KG U-235	
BURNUP(REFUEL)	APPROX, 2 PER CENT	
CONTROL	RODS. REACTIVITY CONTROL BY MOVEMENT OF FUEL.	
COOLANT TEMP.	INLET 200 C	OUTLET 400 C
REACTOR VESSEL	DOUBLE-WALL SS VESSEL, 20 FT. HIGH/10 FT. 6 IN. OD.	
REMARKS	DOUNREAY WAS IN OPERATION IN 1960, SHUT DOWN FOR CORE MODIFICATIONS, WITH RESUMED OPERATION IN AUGUST 1960. LATTICE IS STAR-SHAPED. THE FORM	

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INSTALLED IN 1960 HAS A HEXAGONAL CENTER WHICH IS
MOBILE, FUEL ELEMENT RECHARGING AND CORE
MODIFICATIONS COMPLETED IN OCTOBER 1963,
REFUELING, APRIL 1964. NEWLY DESIGNED
URANIUM-MOLYBDENUM ELEMENTS IN NIOBIUM CANS WERE
LOADED IN 1963. IRRADIATION PROGRAM IS BEING
DEVOTED TO CERAMIC FUELS.

REFERENCES

THE DOUNREAY FAST REACTOR - BASIC PROBLEMS IN
DESIGN,
H CARTWRIGHT, OTHERS
SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY 9, 316-22 /1958/

DOUNREAY,
NUCLEAR POWER 2, 221-48 /JUNE 1957/

DESIGN AND CONSTRUCTION OF THE DFR CORE, REACTOR
VESSEL, FUEL HANDLING EQUIPMENT, AND SHIELDING,
J TATLOCK, OTHERS
J. BRIT. NUCLEAR ENERGY CONF. 6, 166-188
/JULY 1961/

THE FAST BREEDER REACTOR,
RV MOORE, R HURST
J. BRIT. NUCLEAR ENERGY CONF. 6, 161-165
/JULY 1961/

THE DOUNREAY FAST BREEDER REACTOR EXPERIMENT,
JL PHILLIPS, AG FRAME
POWER REACTOR EXPERIMENTS VOL. 1, PP. 295-315
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1962.

PERFORMANCE AND OPERATION OF THE DOUNREAY FAST
REACTOR,
RR MATTHEWS, OTHERS
3RD UN. INTL. CONF. PEACEFUL USES OF ATOMIC ENERGY
GENEVA, 1964. A/CONF. 28/P/130

JANUARY 1967

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LIQUID METAL REACTORS, FOREIGN

FF04

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NAME/OWNER PFR /PROTOTYPE FAST REACTOR/ UK ATOMIC ENERGY AUTH

DESIGNER AEA, UNITED KINGDOM

LOCATION DOUNREAY, SCOTLAND

PURPOSE POWER PROTOTYPE, INTERMEDIATE TO 1000 MWE PLANT

TYPE LIQUID METAL COOLED FAST BREEDER

POWER MWE(MWT) 250 600

CRITICAL TARGET 1970, POWER PRODUCTION 1971

COOLANT SODIUM, PRIMARY AND SECONDARY CIRCUITS

FUEL MATERIAL PLUTONIUM/URANIUM OXIDE
BREEDER MATERIAL U-238 OXIDEFUEL GEOMETRY PIN 8.6 FT. LONG
FUEL 3 FT. PLUS AXIAL BREEDER 9 IN, X 2
AT EACH END

FUEL CLADDING SS CAN 0.15 IN. THICK

FUEL ENRICH. PLUTONIUM/URANIUM 1/3

FUEL ASSEMBLY 325-PIN BUNDLE, HEXAGONAL, 12 1/2 FT. LONG
78 BUNDLES/CORE

BURNUP(REFUEL) 750,000 MWD/T

CONTROL CONTROL AND SHUT-OFF RODS

COOLANT TEMP. INLET 400 C OUTLET 600 C

REACTOR VESSEL PRIMARY VESSEL A CYLINDRICAL TANK 40 FT. DIA. AND
50 FT. DEEP, BELOW GROUND LEVEL.CONTAINMENT REINFORCED CONCRETE VAULT BELOW GROUND LEVEL,
LEAK-TIGHT BUILDINGREMARKS CONSTRUCTION WILL START EARLY IN 1966,
PROJECT INCLUDES A FUEL FABRICATING FACILITY
AT WINDSCALE.
REACTOR VERA AT ALDERMASTON HAS BEEN LOADED WITHREFERENCES APPLIED ATOMICS FEB, 16, 1966 P, 1-4
NJCLEONICS WEEK FEB, 17, 1966 P, 1-2
NEWS RELEASES

JANUARY 1967

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LIQUID METAL REACTORS, FOREIGN

FF04

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POWER FROM PLUTONIUM

W PENNEY

NEW SCIENTIST 29, 484-86 /FEB. 24, 1966/

FAST REACTORS ON THE LINE BY 1971

AG FRAME, RR MATTHEWS

NUCLEONICS 24, 54-59 /SEPT. 1966/

DESIGN OF A PROTOTYPE FAST REACTOR

AG FRAME, BNES FAST REACTOR CONF.

JANUARY 1967

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LIQUID METAL REACTORS, FOREIGN

FF05

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NAME/OWNER FAST BREEDER PROGRAM / W. GERMANY

TYPE LIQUID METAL COOLED FAST BREEDERS. SEE REMARKS

REMARKS IN SUPPORT OF THE PROGRAM TO DEVELOP FAST BREEDER REACTORS, THE KARLSRUHE NUCLEAR RESEARCH CENTER WILL SET UP FOUR NEW EXPERIMENTAL RESEARCH FACILITIES BY 1967. THESE WILL BE A FAST ZERO-ENERGY REACTOR FOR UP TO 300 KG. OF PLUTONIUM /SNEAK/, TO BE COMPLETED BY 1965, A FAST SUBCRITICAL ASSEMBLY KNOWN AS SJAK, THE EXPERIMENTAL FAST CERAMICS REACTOR /EFCR/ TO BE CONSTRUCTED IN THE U. S. IN COLLABORATION WITH THE USAEC, AND INCORPORATION OF A FAST NEUTRON CORE. DEMAG AND AI HAVE INVESTIGATED A ZIRCONIUM HYDRIDE MODERATED REACTOR PROTOTYPE USING SODIUM AS A COOLANT, AND URANIUM CARBIDE AS FUEL. AT KARLSRUHE, PLUTONIUM REACTORS WITH HELIUM, DRY STEAM, AND SODIUM COOLANTS WILL BE TESTED. EURATOM HAS SIGNED A 5-YEAR ASSOCIATION CONTRACT WITH KRB FOR JOINT RESEARCH ON FAST BREEDER. A FAST-THERMAL COUPLED REACTOR, /STARK/ /TRANSFORMATION OF AN EXISTING ARGONAUT-REMOVING THE CENTRAL GRAPHITE COLUMN AND REPLACING IT WITH A FAST-NEUTRON ZONE/ WILL BE COMPLETED SOON. THE EXPERIMENT WILL BE USED FOR REACTOR STUDY, LATER AS A NEUTRON SOURCE FOR INSTRUMENT CALIBRATION.

SEE KNK, SEFOR

A 300 MWE STEAM-COOLED FAST BREEDER PROTOTYPE IS SCHEDULED FOR A 1968 CONSTRUCTION START, TARGET 1973.

SEE IF06

REFERENCES APPLIED ATOMICS, MARCH 6, 1963, P. 4-5.
NEWS RELEASE.

THE KARLSRUHE FAST-THERMAL ARGONAUT REACTOR CONCEPT.

H. MEISTER, OTHERS

KFK-217 /JUNE 1964/

JANUARY 1967

BNWL-326

LIQUID METAL REACTORS, FOREIGN

FF06

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NAME/OWNER	KNK /KOMPAKTES Natrium Kernkraftwerk//W. GERMANY	
DESIGNER	INTERATOM	
LOCATION	KARLSRUHE, W. GERMANY	
PURPOSE	EUROPEAN FAST BREEDER PROGRAM	
TYPE	LIQUID METAL COOLED, ZIRCONIUM HYDRIDE MOD. FAST BREEDER	
POWER MWE(MWT)	20	58
CRITICAL	CONSTRUCTION	
COOLANT	SODIUM	
MODERATOR	ZIRCONIUM HYDRIDE	
FUEL MATERIAL	URANIUM DIOXIDE	
FUEL GEOMETRY	ROD	
FUEL ENRICH.	6.8 PER CENT U-235	
FUEL ASSEMBLY	RING-SHAPED ASSEMBLY, ENCLOSED BETWEEN CENTRAL CYLINDRICAL AND OUTER RING-SHAPED MODERATOR PART 66 FUEL ASSEMBLIES/CORE	
FUEL CHARGE	1.68 TONS FUEL	
BURNUP(REFUEL)	10,000 MWD/T	
CONTROL	RODS, BUILT-IN ABSORBING ELEMENTS	
COOLANT TEMP.	INLET 410 C	OUTLET 560 C
REACTOR VESSEL	DOUBLE TANK, INNER 1.9 M. DIA., 10.5 M. HIGH, SEPARATED FROM SECOND TANK BY NITROGEN ATMOSPHERE.	
CONTAINMENT	17 M. DIA. STRUCTURE INCORPORATING THE REACTOR, HANDLING EQUIPMENT, PRIMARY SODIUM PLANT.	
REMARKS	A 300 MWE PROTOTYPE FAST REACTOR IS SCHEDULED FOR 1968 CONSTRUCTION, PROGRAM INVOLVES SIEMENS, INTERATOM, AND DUTCH COMPANIES, REFERENCE DESIGN FOR A 1000 MWE FAST REACTOR HAS BEEN COMPLETED, SEE FF14	
REFERENCES	KARLSRUHE NUCLEAR RESEARCH CENTER,	

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LIQUID METAL REACTORS, FOREIGN

FF06

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EURONUCLEAR 2, 41-8 /JAN, 1965/

SAFETY ASPECTS OF THE EXPERIMENTAL POWER STATION
KNK

NUCLEAR ENGINEERING 10, 335-37 /SEPT, 1965/

NUCLEONICS WEEK FEB, 3, 1966 P, 7-8
NEWS RELEASE

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BNWL-326

LIQUID METAL REACTORS, FOREIGN

FF07

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NAME/OWNER	BR-5 /SOVIET BREEDER REACTOR//USSR
DESIGNER	USSR
OPERATOR	USSR
LOCATION	OBNINSK, USSR INST. PHYSICS AND POWER ENG. /PHYS-TECH, INST/
PURPOSE	FAST REACTOR R+D
TYPE	LIQUID METAL COOLED, FAST BREEDER
POWER MWE(MWT)	5 KWE 5
CRITICAL	OPERATION SUMMER 1959
COOLANT	SODIUM-POTASSIUM NAK
MODERATOR	NICKEL REFLECTOR, INTERNAL URANIUM REFLECTOR
FUEL MATERIAL	PLUTONIUM DIOXIDE PELLETS 0.4 CM. DIA. BLANKET, URANIUM
FUEL GEOMETRY	PIN, 0.5 CM. OD., ACTIVE LENGTH 28 CM, BLANKET, ROD 0.9 CM. DIA.
FUEL CLADDING	SS TUBES 0.04 CM. WALL THICKNESS
FUEL ASSEMBLY	CORE, 19-PIN ELEMENT 81 ASSEMBLIES/CORE BLANKET, 7-ROD ELEMENT 40 ASSEMBLIES/CORE WITH UC FUEL THERE WOULD BE 100 7-PIN ELEMENTS IN THE CORE.
NEUTRON FLUX	FAST MAX, 1×10^{15}
CONTROL	MOVEMENT OF NICKEL REFLECTOR
COOLANT TEMP.	INLET 806 F OUTLET 932 F
REACTOR VESSEL	SODIUM COOLANT CONTAINER TUBE /ENCLOSES FUEL ASSEMBLIES/, WATER TANK, CAST IRON SHIELD.
CONTAINMENT	CAST IRON AND WATER SHIELDING, HIGH DENSITY CONCRETE STRUCTURE
REMARKS	BR-1, BUILT IN 1955, WAS A 100-WATT PLUTONIUM FUELED REACTOR.

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FF07

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BR-2, BUILT IN 1956, WAS A 100-KWT MERCURY-COOLED, PLUTONIUM FUELED SYSTEM. BR-2 WAS REDESIGNED TO THE BR-5 FAST BREEDER. 50 ELEMENTS CONTAINING URANIUM DIOXIDE REPLACED PLUTONIUM ELEMENTS IN THE CORE ASSEMBLY, AND LATER 8 OF THESE WERE REPLACED BY URANIUM CARBIDE ELEMENTS. BY JANUARY 1965 THE CORE WAS TO BE COMPLETELY URANIUM CARBIDE.

REFERENCES

THE SOVIET FAST REACTOR BR-5.
 RR MATTHEWS
 NUCLEAR ENG. 4, 359-60 /OCTOBER 1959/

SOME PROBLEMS IN THE OPERATION OF THE BR-5 FAST NEUTRON REACTOR.

MS PINKHASIK, OTHERS

AEC-TR-5266

TRANSLATION FROM A PUBLICATION OF THE STATE COMMITTEE OF THE COUNCIL OF MINISTERS OF THE USSR ON THE USE OF ATOMIC ENERGY, MOSCOW, 1961

OPERATIONAL EXPERIENCE WITH THE BR-5 REACTOR.

AI LEIPINSKII, OTHERS

IAEA PREPRINT NO. CN-15/40 /CONFERENCE ON

OPERATIONAL EXPERIENCE WITH ATOMIC POWER REACTORS, VIENNA, JUNE 4-10, 1963/

AEC-TR-5890 /TRANSLATION/

EXPERIMENTAL FAST REACTORS IN THE SOVIET UNION.

AI LEIPINSKY, OTHERS

PROC. 2ND. UN. INTL. CONF. PEACEFUL USES OF ATOMIC ENERGY, GENEVA, 1958. VOL. 9, P. 348-357

NUCLEAR REACTORS IN THE SOVIET UNION.

REPORT OF A RECIPROCAL EXCHANGE TRIP BY US SCIENTISTS, DEC. 11-22, 1964.

WASH-1060

JANUARY 1967

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LIQUID METAL REACTORS, FOREIGN

FF08

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NAME/OWNER BN-50 / USSR

DESIGNER USSR

PURPOSE FEASIBILITY STUDY.

TYPE LIQUID METAL COOLED FAST BREEDER

POWER MWE(MWT) 50 200

CRITICAL DESIGN AND FEASIBILITY STUDY

COOLANT SODIUM

FUEL MATERIAL URANIUM-MOLYBDENUM ALLOY, URANIUM DIOXIDE IN
NICKEL MATRIX, OR SINTERED URANIUM DIOXIDE.

FUEL GEOMETRY RODS

COOLANT TEMP. INLET 315 C OUTLET 450 C

REMARKS PROPOSED PLANT HAS BEEN DISCONTINUED IN FAVOR OF A
350 MWE STATION, REPORTEDLY UNDER CONSTRUCTION.

REFERENCES SODIUM COOLED FAST REACTORS
AT LEIPINSKII, OTHERS
THIRD UN. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964, A/CONF. 28/P/311

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LIQUID METAL REACTORS, FOREIGN

FF09

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NAME/OWNER BN-350 / USSR

DESIGNER USSR

LOCATION SCHEVCHENKO, USSR
EASTERN SHORE OF CASPIAN SEA, MANGYSHLAK
PENINSULA

PURPOSE POWER AND WATER DESALINATION

TYPE LIQUID METAL COOLED FAST BREEDER

POWER MWE(MWT) 350 1000

CRITICAL CONSTRUCTION. TARGET 1969

COOLANT SODIUM

FUEL MATERIAL URANIUM/PLUTONIUM DIOXIDE OR URANIUM CARBIDE
BLANKET, AXIAL AND RADIAL, URANIUM DIOXIDE

FUEL GEOMETRY PIN, 0.6 CM. DIA., 1060 MM. ACTIVE LENGTH
BLANKET, ROD 1.4 CM. OD.

FUEL CLADDING SS
CORE, 0.04 CM. THICK
BLANKET, 0.05 CM.

FUEL ENRICH. OXIDE FUEL, ZONED, 15 AND 20 PER CENT PLUTONIUM
BLANKET, DEPLETED URANIUM
CARBIDE FUEL, 23 PER CENT U-235

FUEL ASSEMBLY CORE, 169-PIN HEXAGONAL ASSEMBLY
211 ASSEMBLIES/CORE
BLANKET, 37-ROD ASSEMBLY
440 ASSEMBLIES
RADIAL AND AXIAL BLANKETS. THE CORE ASSEMBLY
INCLUDES DEPLETED URANIUM DIOXIDE RODS AT EACH END
THE SIDE BLANKET HAS 440 HEXAGONAL ASSEMBLIES IN
SHROUD CANS. ACTIVE LENGTH OF RADIAL BLANKET ROD
IS 1100 MM.

FUEL CHARGE 850 KG. PLUTONIUM-239

BURNUP(REFUEL) MAX. 5 PER CENT 30-33 SUBASSEMBLIES
REPLACED EVERY TWO
MONTHS

NEUTRON FLUX MAX. 8×10^{15}

CONTROL BORON CARBIDE RODS, MOTION OF CENTRAL FUEL

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ASSEMBLIES.
AUTOMATIC SYSTEM

COOLANT TEMP. INLET 572 F OUTLET 932 F

REACTOR VESSEL VARIABLE DIAMETER SS VESSEL, 6000-2200 MM. DIA.,
1300 MM. HIGH
WALL THICKNESS 30 MM.

REMARKS THE FIRST LOADING MAY BE ENRICHED URANIUM DIOXIDE
FUEL. THE 350 MWE REACTOR IS A STEP IN THE
DEVELOPMENT OF POWER REACTORS. THE BN-1000 IS
UNDER DEVELOPMENT. FUEL WILL BE A MIXTURE OF
URANIUM CARBIDE WITH A BREEDING RATIO OF 1.75.
A FAST PILOT REACTOR BOR IS ALSO UNDER DEVELOPMENT
IT WILL BE A 40-60 MWT FACILITY WITH SODIUM
COOLANT TEMPERATURE OUTLET OF 630-650 C
IN BN-350 A BACK-PRESSURE TURBINE WILL BE USED.
DESALINATION CAPACITY WILL BE 1.1×10^6 KG/HR,
FRESH WATER PRODUCTION 100-150 TONS PER DAY.

REFERENCES SODIUM COOLED FAST REACTORS,
A LEIPUNSKI
3RD UN. INTL. CONF. PEACEFUL USES OF ATOMIC ENERGY
GENEVA, 1964. A/CONF. 28/P/311

NUCLEAR REACTORS IN THE SOVIET UNION,
REPORT OF A RECIPROCAL EXCHANGE TRIP TO USSR BY
US SCIENTISTS, DEC. 11-22, 1964.
WASH-1060

NUCLEAR POWER PLANT BN-350
AI LEOPUNSKY, OTHERS
ANS-100 /SUPPLEMENT/ P. 15-26
SEE ALSO JPRS-31193

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LIQUID METAL REACTORS. FOREIGN

FF10

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NAME/OWNER BR-60/USSR
 BOR

DESIGNER USSR

OPERATOR USSR

LOCATION NEW MELEKESS, USSR

PURPOSE EXPERIMENTAL FAST REACTOR

POWER MWE(MWT) 60

CRITICAL CONSTRUCTION

COOLANT SODIUM

FUEL CLADDING SS, THIN-WALL

FUEL ASSEMBLY 37 ASSEMBLIES/CORE

BURNUP(REFUEL) 440-DAY FUEL LIFE

CONTROL BORON CARBIDE RODS, ONE MOVABLE FUEL ELEMENT

COOLANT TEMP. INLET 300-500 C OUTLET 650 C MAX.

REMARKS THE REACTOR HAS SOME SIMILARITY TO US FARET DESIGN

REFERENCES NUCLEAR REACTORS IN THE SOVIET UNION.
 REPORT OF A RECIPROCAL EXCHANGE TRIP TO USSR BY
 US SCIENTISTS, DEC. 11-22, 1964,
 WASH-1060

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LIQUID METAL REACTORS, FOREIGN

FF11

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NAME/OWNER BN-1000/USSR

DESIGNER USSR

OPERATOR USSR

POWER MWE(MWT) 1000

CRITICAL PROPOSED, DESIGN AND DEVELOPMENT

FUEL MATERIAL URANIUM/PLUTONIUM CARBIDE
OR URANIUM CARBIDE

FUEL ASSEMBLY CORE WILL BE FLATTER THAN BN-350 CORE

REFERENCES NUCLEAR REACTORS IN THE SOVIET UNION,
REPORT OF A RECIPROCAL EXCHANGE TRIP TO USSR BY
US SCIENTISTS, DEC. 11-22, 1964,
WASH-1060

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LIQUID METAL REACTORS, FOREIGN

FF12

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NAME/OWNER PHENIX/CEA, FRANCE

DESIGNER CEA, FRANCE

PURPOSE INTERMEDIATE SYSTEM BETWEEN RAPSODIE AND A
1000MWE POWER REACTOR

TYPE LIQUID METAL COOLED FAST BREEDER

POWER MWE(MWT) 125-150

CRITICAL DESIGN. CONSTRUCTION TARGET 1969

COOLANT SODIUM, FLOW IS UPWARD

FUEL MATERIAL URANIUM/PLUTONIUM DIOXIDE PELLETS 6 MM. DIA.
FERTILE MATERIAL URANIUM DIOXIDE PELLETS
15 MM. DIA.

FUEL GEOMETRY PIN 6-6.85 MM. OD.

FUEL CLADDING SS 0.35 MM. THICK

FUEL ENRICH. ZONED
INNER 14.6 PER CENT PLUTONIUM
OUTER 21.8 PER CENT PLUTONIUM

FUEL ASSEMBLY FUEL BUNDLES IN HEXAGONAL TUBES
CORE ASSEMBLIES 217 FISSILE PINS
2 BUNDLES OF 37 FERTILE PINS

SPECIFIC POWER 1 MW/KG PLUTONIUM

BURNUP(REFUEL) 60,000-100,000 MWD/T

CONTROL VERTICAL RODS, BORON CARBIDE IN HEXAGONAL SHEATHS

REMARKS MIXED CARBIDE AND NITRIDE FUELS WILL BE STUDIED,
AS WELL AS OTHER CLADDING MATERIALS SUCH AS
VANADIUM AND SOME NICKEL ALLOYS.

REFERENCES SOME ESSENTIAL ASPECTS OF THE STUDY OF LARGE
REACTORS, PRESENT SITUATION AND ORIENTATION.
CEA SERVICE D-ETUDES DES PILES RAPIDES
BUL. D-INFORM. SCI. TECH. NO. 95 P. 80-9 /JUL-AUG
1965/

PRELIMINARY STUDIES LEADING TO A CONCEPT OF A
1000 MWE FAST REACTOR
G VENDRYES, OTHERS

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LIQUID METAL REACTORS, FOREIGN

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CEA-R-2554

JANUARY 1967

BNWL=326

LIQUID METAL REACTORS. FOREIGN

FF13

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NAME/OWNER FAST BREEDER REACTOR DESIGN/JAERI, JAPAN
 DESIGNER JAPAN ATOMIC ENERGY RESEARCH INST./JAERI/
 PURPOSE EXPERIMENTAL REACTOR
 TYPE LIQUID METAL COOLED FAST BREEDER
 POWER MWE(MWT) 100
 CRITICAL DESIGN. CONSTRUCTION 1968, TARGET 1971
 COOLANT SODIUM
 FUEL MATERIAL URANIUM DIOXIDE
 FUEL GEOMETRY CORE
 PIN, 5.4 MM. DIA.,
 ACT. LENGTH 600 MM. + 2X300 MM, AXIAL
 BLANKET
 RADIAL BLANKET
 ROD, 13.5 MM. DIA., ACT. LENGTH 1200 MM.
 FUEL CLADDING CLAD WILL BE 0.25 MM. THICK ON CORE ELEMENTS AND
 0.60 MM. THICK FOR RADIAL BLANKET ELEMENTS
 FUEL ENRICH. 50 PER CENT U-235
 BLANKET DEPLETED URANIUM
 FUEL ASSEMBLY CORE, 88-PIN - CORE + AXIAL BLANKET- BUNDLE
 55 ASSEMBLIES
 RADIAL BLANKET, 19-ROD ASSEMBLY
 65 ASSEMBLIES
 NEUTRON FLUX AVE. 2.8×10^{15}
 COOLANT TEMP. INLET 250 C OUTLET 400 C
 REFERENCES PRELIMINARY DESIGN WORK OF THE 100 MWT
 EXPERIMENTAL FAST REACTOR
 T TETSUO, OTHERS
 NP-15572 /SEPT. 1, 1965/
 JAPAN FAST CRITICAL EXPERIMENT PROGRAM
 JAPAN ATOMIC ENERGY RESEARCH INSTITUTE
 NP-15573 /SEPT. 25, 1965/

JANUARY 1967

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LIQUID METAL REACTORS, FOREIGN

FF14

NAME/OWNER KARLSRUHE LARGE FAST POWER REACTOR/W. GERMANY
NA=1, FTR

DESIGNER: KARLSRUHE CENTER, W. GERMANY

PURPOSE	POWER
1. To determine the effect of the proposed changes on the company's financial performance.	1. To determine the effect of the proposed changes on the company's financial performance.
2. To determine the effect of the proposed changes on the company's operational performance.	2. To determine the effect of the proposed changes on the company's operational performance.
3. To determine the effect of the proposed changes on the company's customer satisfaction.	3. To determine the effect of the proposed changes on the company's customer satisfaction.
4. To determine the effect of the proposed changes on the company's employee satisfaction.	4. To determine the effect of the proposed changes on the company's employee satisfaction.
5. To determine the effect of the proposed changes on the company's market share.	5. To determine the effect of the proposed changes on the company's market share.
6. To determine the effect of the proposed changes on the company's brand reputation.	6. To determine the effect of the proposed changes on the company's brand reputation.
7. To determine the effect of the proposed changes on the company's overall performance.	7. To determine the effect of the proposed changes on the company's overall performance.
8. To determine the effect of the proposed changes on the company's competitive advantage.	8. To determine the effect of the proposed changes on the company's competitive advantage.
9. To determine the effect of the proposed changes on the company's long-term sustainability.	9. To determine the effect of the proposed changes on the company's long-term sustainability.
10. To determine the effect of the proposed changes on the company's future growth.	10. To determine the effect of the proposed changes on the company's future growth.

TYPE LIQUID METAL COOLED FAST BREEDER

POWER MWE(MWT)	1000	2500
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CRITICAL DESIGN

COOLANT SODIUM

FUEL MATERIAL URANIUM/PLUTONIUM DIOXIDE
FERTILE MATERIAL URANIUM DIOXIDE OR METAL

FUEL GEOMETRY CORE, PIN 6.7 MM. DIA.
BLANKET, PIN 11.3 MM. DIA.

FUEL CLADDING INCOLOY
CORE 0.35 MM. THICK
BLANKET 0.6 MM. THICK

FUEL ASSEMBLY CORE
HEXAGONAL CELL, 331 PINS
105 SUBASSEMBLIES PER REGION 1 AND 2
BLANKET
169-PIN ASSEMBLY
RADIAL BLANKET, ZONE 3, 60 SUBASSEMBLIES
ZONE 4, 108 SUBASSEMBLIES
OUTER RADIAL BLANKET COMPOSED OF URANIUM
METAL PINS /ZONE 4/

BURNUP (REFUEL) AVE. 85,000 MWD/T URANIUM+PLUTONIUM

NEUTRON FLUX TOTAL, CORE CENTER 10 E+16

COOLANT TEMP. INLET 430 C OUTLET 580 C

REACTOR VESSEL SS VESSEL 16,900 MM. HIGH, 7900 MM. OD.,
WALL THICKNESS 30 MM.

REMARKS	REFERENCE DESIGN
1. The design is based on the assumption that the material is homogeneous and isotropic.	1. The design is based on the assumption that the material is homogeneous and isotropic.
2. The design is based on the assumption that the material is perfectly elastic.	2. The design is based on the assumption that the material is perfectly elastic.
3. The design is based on the assumption that the material is perfectly plastic.	3. The design is based on the assumption that the material is perfectly plastic.
4. The design is based on the assumption that the material is perfectly brittle.	4. The design is based on the assumption that the material is perfectly brittle.
5. The design is based on the assumption that the material is perfectly ductile.	5. The design is based on the assumption that the material is perfectly ductile.
6. The design is based on the assumption that the material is perfectly elastic-plastic.	6. The design is based on the assumption that the material is perfectly elastic-plastic.
7. The design is based on the assumption that the material is perfectly elastic-plastic-brittle.	7. The design is based on the assumption that the material is perfectly elastic-plastic-brittle.
8. The design is based on the assumption that the material is perfectly elastic-plastic-ductile.	8. The design is based on the assumption that the material is perfectly elastic-plastic-ductile.
9. The design is based on the assumption that the material is perfectly elastic-plastic-brittle-ductile.	9. The design is based on the assumption that the material is perfectly elastic-plastic-brittle-ductile.
10. The design is based on the assumption that the material is perfectly elastic-plastic-brittle-ductile-plastic.	10. The design is based on the assumption that the material is perfectly elastic-plastic-brittle-ductile-plastic.

REFERENCES THE KARLSRUHE REFERENCE DESIGN OF A 1000 MWE
SODIUM COOLED FAST BREEDER REACTOR /FTR/
W. HAFELE, OTHERS
KFK-369 /OCT. 1965/

ORGANIC COOLED REACTORS

DOMESTIC

JANUARY 1967

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ORGANIC COOLED REACTORS, DOMESTIC

GD01

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NAME/OWNER	POPR /PROTOTYPE ORGANIC POWER REACTOR//AEC	
DESIGNER	ATOMICS INTERNATIONAL	
PURPOSE	POWER PROTOTYPE	
TYPE	ORGANIC MODERATED AND COOLED REACTOR	
POWER MWE(MWT)	50	160
CRITICAL	PROPOSAL	
COOLANT	LIQUID HYDROCARBON	
MODERATOR	LIQUID HYDROCARBON	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	PIN	
FUEL CLADDING	APM-ALUMINUM POWDERED METAL FINNED TUBING	
FUEL ASSEMBLY	54 PINS/ASSEMBLY /HEXAGONAL APM BOX WITH CENTRAL TUBE/ 121 ASSEMBLIES/CORE	
BURNUP(REFUEL)	9000 MWD/TON	
NEUTRON FLUX	THERMAL 3×10^{13}	
CONTROL	RODS, SS TUBES WITH BORDON CARBIDE AT CENTER OF ELEMENTS,	
COOLANT TEMP.	INLET 644 F	OUTLET 700 F
REACTOR VESSEL	CYLINDRICAL, 11 FT. 6 IN. ID. AT UPPER PLENUM, 8 FT. 6 IN. AT CORE REGION, 6 FT. AT BOTTOM SECTION, CYLINDRICAL INNER TANK CONTAINS CORE.	
CONTAINMENT	REACTOR BUILDING /PRESSURE VESSEL/ 85 FT. DIA./160 FT. HIGH	
REMARKS	AEC PROGRAM INITIATED IN JANUARY 1961, PROPOSAL BY GRAND RIVER DAM AUTHORITY REFUSED BY AEC. A PROPOSAL WAS SUBMITTED TO AEC FOR A 30 MWE 160 MWT PROCESS HEAT REACTOR FOR PACKAGING CORPORATION OF AMERICA'S PLANT AT FILER CITY, MICHIGAN.	
REFERENCES	THE 50 MWE PROTOTYPE ORGANIC NUCLEAR PLANT.	

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GD01

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CW WHEELLOCK, GS BUDNEY
ASME PREPRINT 61-WA-226 /1961/

PRELIMINARY POPR CONCEPTUAL DESIGN EXCURSION STUDY
FJ HALFEN
NAA-SR-MEMO-6448 /JUNE 1961/

PROTOTYPE ORGANIC POWER REACTOR,
ATOMICS INTERNATIONAL
NAA-SR-7400 /SECT. IV/ /NOVEMBER 15, 1962/

JANUARY 1967

BNWL=326

ORGANIC COOLED REACTORS, DOMESTIC

GD02

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NAME/OWNER OMRE /ORGANIC MODERATED REACTOR EXP.//AEC-AI
DESIGNER ATOMICS INTERNATIONAL
OPERATOR ATOMICS INTERNATIONAL
LOCATION NATIONAL REACTOR TEST. STATION, IDAHO
PURPOSE POWER EXPERIMENT, DEMONSTRATION
TYPE ORGANIC MODERATED AND COOLED, CIRCULATING COOLANT
MODERATOR
POWER MWE(MWT) 5-15
CRITICAL SEPT. 1957
COOLANT ORGANIC LIQUID /TERPHENYL/
MODERATOR ORGANIC LIQUID /TERPHENYL/
FUEL MATERIAL URANIUM DIOXIDE IN SS MATRIX, 20 MILS THICK
FUEL GEOMETRY PLATES ACTIVE AREA 36 IN. / 2 1/2 IN.
FUEL CLADDING SS 5 MILS THICK
FUEL ENRICH. HIGH
FUEL ASSEMBLY 16 PLATES PER BOX /2.9/2.8/60 IN./
31 BOXES / CORE
FUEL CHARGE 25.5 KG. U-235
SPECIFIC POWER 470 KW/KG U-235
NEUTRON FLUX THERMAL AVE. 4.1×10^{13}
FAST AVE. 1.8×10^{14}
CONTROL CYLINDRICAL RODS
COOLANT TEMP. INLET 500-700 F OUTLET 520-710 F
COOLANT PRESS. 200 PSIG
REACTOR VESSEL LOW ALLOY STEEL, 4.5 FT. ID.
CONTAINMENT NONE EXCEPT FOR REACTOR VESSEL AND PRIMARY COOLANT
PIPING
REMARKS OPERATION FEBRUARY 1958. WAS SHUT DOWN FOR

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ORGANIC COOLED REACTORS, DOMESTIC

GD02

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SECOND CORE LOADING. PROJECT WAS PHASED OUT IN
MID-1963. THE OMRE, A PRESSURIZED SYSTEM, WAS
SPECIFICALLY DESIGNED AS A TEST FACILITY FOR
ORGANICS, WITH NO PROVISION FOR ELECTRICITY
GENERATION. COOLANT-MODERATOR LIQUID WAS
SANTOWAX O.M.

REFERENCES

OMRE
NUCLEAR ENG. 2/21/, 521 /DECEMBER 1957/

CONCEPTUAL DESIGN STUDY OF OMRE MODIFICATIONS.
WB WOLFE
NAA-SR-MEMO-3881 /JULY 1959/

ORGANIC MODERATED REACTOR EXPERIMENT SAFEGUARDS
SUMMARY.
HL SLETTEW, ED.
NAA-SR-2323 /FEBRUARY 1, 1958/

JANUARY 1967

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ORGANIC COOLED REACTORS, DOMESTIC

GD03

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NAME/OWNER	PIQUA NUCLEAR POWER FACILITY/AEC-CITY OF PIQUA	
DESIGNER	ATOMICS INTERNATIONAL	
OPERATOR	CITY OF PIQUA	
LOCATION	PIQUA, OHIO	
PURPOSE	POWER DEMONSTRATION	
TYPE	ORGANIC MODERATED AND COOLED	
POWER MWE(MWT)	11.4	45.5
CRITICAL	JUNE 1963, ON-LINE NOV. 1963	
COOLANT	TERPHENYL /SINGLE COOLANT LOOP/	
MODERATOR	TERPHENYL	
FUEL MATERIAL	URANIUM-MOLYBDENUM-ALUMINUM ALLOY	
FUEL GEOMETRY	DOUBLE ANNULAR TUBES. INNER ANNULUS 3.6 IN. DIA./0.208 IN. THICK OUTER 4.63 IN. DIA./0.208 IN. THICK TOTAL ACTIVE LENGTH 54 IN.	
FUEL CLADDING	ALUMINUM TUBES, CONCENTRIC, FINNED	
FUEL ENRICH.	1.9 PER CENT U-235	
FUEL ASSEMBLY	NESTED FUEL ASSEMBLIES, 4 SETS OF COAXIAL TUBULAR ELEMENTS-STACKED /FULL CORE LENGTH/ IN THIN WALLED SS COOLANT DUCT. 85 ASSEMBLIES/CORE /13CONTAIN CONTROL RODS/ 72 REGULAR FUEL ASSEMBLIES	
FUEL CHARGE	6550 KG. URANIUM	
BURNUP(REFUEL)	1000 MWD/TON	1/4 CORE BATCHES
NEUTRON FLUX	THERMAL AVE. 1.9×10^{13} FAST AVE. 4×10^{13}	
CONTROL	RODS, BORON CARBIDE IN SMALL SS TUBES BRAZED TOGETHER TO FORM DOUBLE RING	
COOLANT TEMP.	INLET 519 F	OUTLET 575 F
COOLANT PRESS.	120 PSIA	

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GD03

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REACTOR VESSEL MILD STEEL CYLINDRICAL VESSEL 92 IN. ID./27 FT.
3 1/2 IN. HIGH

CONTAINMENT STEEL-BUILDING WITH INNER CONCRETE LINING
ABOVE-GRADE, VERTICAL CYLINDER, 73 FT. DIA/85 FT.
HIGH

REMARKS INITIALLY THE NORMAL CORE LOADING WAS DECREASED BY
ABOUT 13 ASSEMBLIES, WITH DUMMY ASSEMBLIES
REPLACING THESE TO REDUCE EXCESS REACTIVITY.
COOLANT ENTERS THE CORE FROM THE TOP, FLOWS
DOWNWARD THROUGH THE CORE AND THEN UPWARD IN THE
ANNULUS BETWEEN THE GRID SUPPORT BARREL AND THE
PRESSURE VESSEL TO THE OUTLET NOZZLE. THE SINGLE
COOLANT LOOP CONSISTS OF TWO COOLANT PUMPS, A
SUPERHEATER, AND A STEAM GENERATOR. CRITICAL
JUNE 1963. ON-LINE NOVEMBER 1963.

REFERENCES ENGINEERING DESIGN OF THE PIQUA OMR.
EF WEISNER
NUCLEAR ENG. 5, 68-9 /FEBRUARY 1960/

SELECTION OF THE PIQUA OMR FUEL ELEMENT.
EB BAUMEISTER
NAA-SR-4239 /MARCH 15, 1960/

THE PIQUA NUCLEAR POWER FACILITY.
EF WEISNER
PROC. ORGANIC COOLED REACTOR FORUM, P. 211-224
/OCTOBER 1960/
NAA-SR-5688 /DECEMBER 1960/

FINAL SAFEGUARDS SUMMARY REPORT FOR THE PIQUA
NUCLEAR POWER FACILITY.
ATOMICS INTERNATIONAL
NAA-SR-5608 /AUGUST 1961/

DESIGN PRACTICE. PIQUA NUCLEAR POWER FACILITY
POWER REACTOR TECHNOLOGY 5/4/, 51-60 /SEPT. 1962/

JANUARY 1967

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ORGANIC COOLED REACTORS. DOMESTIC

GD04

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NAME/OWNER	EDCR /EXP. ORGANIC COOLED REACTOR//AEC	
DESIGNER	ATOMICS INTERNATIONAL CONCEPTUAL DESIGN, PHILLIPS PETROLEUM	
OPERATOR	ATOMICS INTERNATIONAL	
LOCATION	NATIONAL REACTOR TEST. STATION, IDAHO	
PURPOSE	TEST BED FOR FUEL ELEMENTS, ORGANIC COOLANTS.	
TYPE	ORGANIC MODERATED AND COOLED	
POWER MWE(MWT)	40	
CRITICAL:	POSTPONED	
COOLANT	TERPHENYL	
MODERATOR	TERPHENYL	
FUEL MATERIAL	URANIUM DIOXIDE IN SS MATRIX 0.020 IN. THICK	
FUEL GEOMETRY	PLATES	
FUEL CLADDING	SS 0.005 IN. THICK	
FUEL ENRICH.	HIGH	
FUEL ASSEMBLY	28 PLATES + 1 DUMMY SPACER PLATE TO BOX 7/6 1/2 IN. / 32 FUEL UNITS /20 DRIVER FUEL ELEMENTS AND 12 CONTROL-ROD FOLLOWERS/	
CONTROL	RODS-FUEL FOLLOWER TYPE	
COOLANT TEMP.	INLET 500 F	OUTLET 525 F.
COOLANT PRESS.		OUTLET 157 PSI
REACTOR VESSEL	CARBON STEEL, 95 IN. ID./32 FT. LONG. CORE IS ENCLOSED IN AN INNER TANK	
REMARKS	THIS PROJECT HAS BEEN INDEFINITELY DEFERRED WITH THE PLANT 99 PER CENT COMPLETE. CORE DESIGN CONSISTS OF RECTANGULAR FUEL ASSEMBLIES COMPOSED OF TWO SUBASSEMBLIES. SUBASSEMBLY CONTAINS 28 ACTIVE PLATES AND ONE DUMMY PLATE, THE ACTIVE PLATES BEING OF HIGHLY ENRICHED URANIUM DIOXIDE-SS WITH STAINLESS STEEL CLADDING. CONCEPTUAL DESIGN	

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GD04

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WAS BY PHILLIPS.

REFERENCES

EXPERIMENTAL ORGANIC COOLED REACTOR CONCEPTUAL
DESIGN.

WE NYER, JH RAINWATER

IDO-16570 /DECEMBER 1, 1959/

EXPERIMENTAL ORGANIC COOLED REACTOR.

MR DUSBABEK

NAA-SR-5688 /P. 189-210/ /DECEMBER 1960/

EXPERIMENTAL ORGANIC COOLED REACTOR, PRELIMINARY
HAZARDS REPORT, ADDENDUM.

FLUOR CORP.

IDO-24034

IDO-24034 /ADD, / /NOVEMBER 1960/

IDO-24034 /ADD. 2/ /APRIL 1961/

THE EXPERIMENTAL ORGANIC COOLED REACTOR.

POWER REACTOR TECHNOLOGY 5/1, 88-91 /DEC. 1961/

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ORGANIC COOLED REACTORS. DOMESTIC

GD05

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NAME/OWNER	OMR-SHIP PROPULSION STUDY / AI
DESIGNER	ATOMICS INTERNATIONAL
PURPOSE	SHIP PROPULSION
TYPE	ORGANIC MODERATED AND COOLED
POWER MWE(MWT)	10,000 SHP 30-36
CRITICAL	DESIGN
COOLANT	ORGANIC LIQUID
MODERATOR	ORGANIC LIQUID
FUEL MATERIAL	URANIUM DIOXIDE PELLETS OR URANIUM-MOLYBDENUM ALLOY
FUEL GEOMETRY	RODS /TUBES/
FUEL CLADDING	SS TUBING OR ALUMINUM TUBING WITH URANIUM-MOLYBDENUM ALLOY FUEL
FUEL ENRICH.	APPROX. 3.7 PER CENT U-235
FUEL ASSEMBLY	100-ROD ASSEMBLY /SS BOX/
CONTROL	RODS
COOLANT TEMP.	INLET 300 C OUTLET 325C
CONTAINMENT	CONTAINMENT SHELL WITHIN GAS-TIGHT REACTOR COMPARTMENT.
REMARKS	REFERENCE DESIGN FOR AN OMR-POWERED TANKER, WAS CONSIDERED UNDER AN INTERATOM DESIGN PROPOSAL FOR THE GKSS /GERMAN/ SHIP PROGRAM.
REFERENCES	REFERENCE DESIGN FOR AN OMR-POWERED 38,000 DWT TANKER RJ GIMERA, RE STANBRIDGE NAA-SR-1851 AND SUPPLEMENT /MARCH 1957/ MARITIME ORGANIC MODERATED AND COOLED REACTOR. NAA-SR-3859 THE INTERATOM MARINE REACTOR. FE FARIS NUCLEAR POWER 6. 75-6 /MARCH 1961/

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SKETCH OF A SHIP REACTOR COOLED AND MODERATED
WITH ORGANIC SUBSTANCES,
KERNREAKTOREN FÜR SCHIFFSANTRIEBE, P .33-6
VERLAG KARL THIEMIG AG. MUNICH, 1961

JANUARY 1967

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GD06

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NAME/OWNER DCDR /DIRECT CYCLE DIPHENYL REACTOR//MARQUARDT
CORP.

DESIGNER MARQUARDT CORP.

PURPOSE POWER AND/OR PROCESS HEAT

TYPE ORGANIC MODERATED AND COOLED, DIRECT CYCLE

CRITICAL STUDY, PROTOTYPE PROPOSED

COOLANT DIPHENYL

MODERATOR DIPHENYL

FUEL MATERIAL URANIUM CARBIDE

FUEL CLADDING GRAPHITE

FUEL ENRICH. SLIGHT

COOLANT TEMP. 850 F

COOLANT PRESS. 400 PSIA

REACTOR VESSEL LOW-ALLOY STEEL

REMARKS R + D PROPOSAL, CONCEPTUAL DESIGN /DIRECT CYCLE
DIPHENYL REACTOR/. CONCEPT FOR POWER AND/OR
PROCESS HEAT. APPLICATION HAS BEEN MADE TO THE
AEC FOR R + D ASSISTANCE. MARQUARDT HAS ALSO
PROPOSED CONSTRUCTION OF THE DCDR AS A DUAL
PURPOSE REACTOR FOR WATER DESALINATION AND POWER
PRODUCTION. PROPOSALS HAVE BEEN SENT TO THE
COMMUNITIES OF CATALINA, SAN DIEGO, AND LONG BEACH
CALIF.

REFERENCES NUCLEONICS WEEK, SEPTEMBER 27, 1962, P. 3,
NEWS RELEASE

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GD07

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NAME/OWNER DMFBR /ORGANIC MOD. FLUIDIZED BED REACTOR//WEST

DESIGNER WESTINGHOUSE ELECTRIC CORPORATION

PURPOSE POWER

TYPE ORGANIC MODERATED AND COOLED, FLUIDIZED BED.

POWER MWE(MWT) 50 150

CRITICAL CONCEPTUAL DESIGN. DEVELOPMENT PROPOSED.

COOLANT POLYPHENYL

MODERATOR POLYPHENYL

FUEL MATERIAL URANIUM

FUEL GEOMETRY SPHERES

FUEL ENRICH. APPROX. 2 PER CENT U-235

FUEL ASSEMBLY FLUIDIZED BED OF URANIUM PELLETS.
COOLANT IS HEATED ON PASSING THROUGH THE FUEL BED.

FUEL CHARGE 15 TONS URANIUM

CONTROL RATE OF COOLANT CIRCULATION.

COOLANT TEMP. INLET 610 F OUTLET 690 F

REACTOR VESSEL STRUCTURAL STEEL

REMARKS PROPOSAL FOR DEVELOPMENT /BURLINGTON, VT. LIGHT
DEPT./ . CURRENT STATUS UNKNOWN.

REFERENCES ATOMIC DEVELOPMENT AT WESTINGHOUSE,
POWER ENG. 62. 44-50 /DECEMBER 1958/

ORGANIC MODERATED FLUIDIZED BED REACTOR CONCEPT.
JH WRIGHT
TRANS. ANS 1/2/. 126-7 /DEC. 1958/

JANUARY 1967

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ORGANIC COOLED REACTORS. DOMESTIC

GD08

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NAME/OWNER	HWOOR /HEAVY WATER ORGANIC COOLED REACTOR/ AEC	
DESIGNER	ATOMICS INTERNATIONAL, COMBUSTION ENGINEERING	
PURPOSE	POWER	
TYPE	HEAVY WATER MODERATED, ORGANIC COOLED PRESSURE TUBE /CALANDRIA/	
POWER MWE(MWT)	1000	3093
CRITICAL	DEVELOPMENT	
COOLANT	ORGANIC LIQUID	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	FUELS TO BE TESTED WILL INCLUDE SAP-CLAD URANIUM CARBIDE, ZIRCONIUM-CLAD URANIUM DIOXIDE, AND SAP-CLAD URANIUM DIOXIDE CONCEPTUAL DESIGN, URANIUM CARBIDE	
FUEL GEOMETRY	ROD, 0.324 AND 0.523 IN. OD.	
FUEL CLADDING	SAP	
FUEL ENRICH.	1.16 PER CENT U-235	
FUEL ASSEMBLY	37-ROD BUNDLE 5 ELEMENTS STACKED PER FUEL CHANNEL 492 CHANNELS	
BURNUP(REFUEL)	GOAL IS 20,000 MWD/T	
CONTROL	ROD	
COOLANT TEMP.	INLET 595 F	OUTLET 750 F
REACTOR VESSEL	MODERATING AND SHIELDING CALANDRIA TANKS, VERTICAL ORIENTATION. PROCESS TUBES ARE INSULATED FROM THE MODERATOR.	
REMARKS	DESIGN WORK WILL NOT BE STARTED BEFORE LATE 1966. FUEL TESTS WILL BE DONE IN AN ORGANIC LOOP IN CANADA'S NRU AND IN THE CANADIAN WR-1	
REFERENCES	NEWS RELEASES HEAVY WATER ORGANIC COOLED REACTOR 1000 MWE NUCLEAR POWER PLANT, PRELIMINARY	

GD08

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ORGANIC COOLED REACTORS. DOMESTIC

GD08

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CONCEPTUAL DESIGN

VOL. 1, ECONOMIC ANALYSIS

VOL. 2, PLANT DESCRIPTION

COMBUSTION ENGINEERING

A1-CE-MEMO-6 /VOL. 1 AND 2/ /OCT. 1, 1965/

ORGANIC COOLED REACTORS

FOREIGN

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ORGANIC COOLED REACTORS, FOREIGN

GF01

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NAME/OWNER	PRO /PROGRAMMA REATTORE ORGANICO/ CNEN, ITALY
DESIGNER	CNEN, ITALY
OPERATOR	SORIN-AGIP
LOCATION	BOLOGNA, N. ITALY
PURPOSE	POWER PROTOTYPE
TYPE	ORGANIC MODERATED AND COOLED
POWER MWE(MWT)	30 /2ND CORE 60 MWT/
CRITICAL	CONSTRUCTION
COOLANT	ORGANIC LIQUID
MODERATOR	ORGANIC LIQUID
FUEL MATERIAL	URANIUM DIOXIDE IN SS MATRIX, FIRST CORE. THORIUM WILL ALSO BE USED IN A THORIUM/URANIUM-233 CYCLE.
FUEL GEOMETRY	PLATE /APPR-TYPE/
FUEL CLADDING	SS /LATER SAP/
FUEL ENRICH.	HIGH
COOLANT TEMP.	315-330 C
COOLANT PRESS.	30 KG/SQ. CM.
REMARKS	A NUMBER OF CORES HAVE BEEN EXAMINED FOR THE PURPOSE OF GIVING THE PLANT AN INCREASED FLEXIBILITY FOR SECOND CORES. TWO MAJOR R+D PROGRAMS ARE IN PROGRESS, PRO, THE ORGANIC REACTOR PROGRAM FOR A 30 MWT REACTOR, AND PCUT, THE URANIUM THORIUM CYCLE PROGRAM WHICH VISUALIZES A URANIUM-THORIUM REPROCESSING PILOT PLANT. AIM IS TO STUDY THE URANIUM-THORIUM CYCLE WITH A VIEW TO A POWER REACTOR-REPROCESSING PLANT INTEGRATED COMPLEX. A ZERO-POWER EXPERIMENT ROSPO /REATTORE ORGANICO SPERIMENTALE A POTENZA 0/ IS IN PROGRESS AT CASACCIA.
REFERENCES	THE CNEN PROGRAM FOR REACTORS WITH ORGANIC LIQUID AND THE URANIUM-THORIUM CYCLE, F IPPOLITO, OTHERS

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ORGANIC COOLED REACTORS, FOREIGN

GF01

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ENERGIA NUCLEARE /MILAN/ 8, 196-208 /MARCH 1961/

PRO REACTOR OPTIMIZATION CRITERIA,

S BALDETTI, OTHERS

ENERGIA NUCLEARE /MILAN/ 8, 413-21 /JUNE 1961/

JANUARY 1967

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ORGANIC COOLED REACTORS. FOREIGN

GF02

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NAME/OWNER	ARBUS /ARCTIC MODULAR PLANT//USSR	
DESIGNER	USSR	
OPERATOR	USSR	
LOCATION	MELEKES, ULYANOVSK DISTRICT, RUSSIA	
PURPOSE	PORTABLE POWER REACTOR.	
TYPE	ORGANIC MODERATED AND COOLED, TRANSPORTABLE PLANT.	
POWER MWE(MWT)	750 KWE	5
CRITICAL	OCTOBER 1963. PILOT OPERATION JUNE 1963	
COOLANT	ORGANIC LIQUID	
MODERATOR	ORGANIC LIQUID	
FUEL MATERIAL	URANIUM-ALUMINUM ALLOY OR ALUMINUM-URANIUM DIOXIDE CERMET.	
FUEL GEOMETRY	PLATES OR HEXAGONAL TUBES	
FUEL CLADDING	ALUMINUM	
FUEL ENRICH.	36 PER CENT U-235	
FUEL ASSEMBLY	HEXAGONAL PLATES /ASSEMBLIES OF 3 HEX. TUBES/ 69 PLATES/CORE	
FUEL CHARGE	62 KG. URANIUM	
BURNUP(REFUEL)	APPROX. 2 YEARS	
CONTROL	BORON STEEL RODS AND BORON CARBIDE RODS	
COOLANT TEMP.	INLET 230 C	OUTLET 243 C
COOLANT PRESS.	10 ATM.	
REACTOR VESSEL	WELDED CYLINDER 4365 MM. HIGH, 1340 MM, DIA., 20 MM. WALL THICKNESS. INNER VESSEL TO FORM COOLANT FLOW AND AS CORE SUPPORT STRUCTURE. EQUIPMENT, FITTINGS AND PIPES ARE CARBON STEEL /PRIMARY CIRCUIT/.	
CONTAINMENT	PLANT CONSISTS OF 19 UNITS, NO GREATER THAN 20 TONS EACH. ARBUS OCCUPIES A 12.36 / 28.5 M.	

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ORGANIC COOLED REACTORS, FOREIGN

GF02

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BUILDING 6.36 M. HIGH.

REMARKS

COOLANT WILL BE CONTINUOUSLY CLEANED BY FILTRATION THROUGH METAL-CERAMIC FILTERS. CHEMICAL PURIFICATION WILL BE BY DISTILLATION. STANDARD INDUSTRIAL AND REFINERY EQUIPMENT OF LOW CARBON STEEL IS USED THROUGHOUT.

REFERENCES

ATOMIC ENERGY IN THE SOVIET UNION. TRIP REPORT OF THE U. S. ATOMIC ENERGY DELEGATION, MAY 1963.

ARBUS-SOVIET MODULAR NUCLEAR POWER PLANT
N SINEV
NUCLEAR ENGINEERING 8.429 /DEC, 1963/

STARTUP OF THE WORLD-S FIRST ATOMIC POWER STATION WITH AN ORGANIC-COOLED, ORGANIC MODERATED REACTOR, YU ARKHANGEL-SKII, I KOVALEV
AT. ENERG. /USSR/ 15.443 /NOV, 1963/

THE ARBUS ORGANIC COOLED AND MODERATED NUCLEAR POWER STATION,
KK POLUSHKIN, OTHERS
THIRD U.N. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY, MAY 1964, A/CONF. 28/P/307

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BNWL-326

ORGANIC COOLED REACTORS. FOREIGN

GF03

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NAME/OWNER KBWP PROJECT/KBWP, W. GERMANY

DESIGNER INTERATOM

OPERATOR KERNKRAFTWERK BADENWURTTENBERG PLANNINGSGESELLSCHAFT MBH, FORMERLY AKS, W. GERMANY

LOCATION OBRIGHEIM, BADEN, W. GERMANY

PURPOSE POWER

TYPE ORGANIC MODERATED AND COOLED

POWER MWE(MWT) 150

CRITICAL PLANNED

COOLANT ORGANIC LIQUID

MODERATOR ORGANIC LIQUID

REMARKS DESIGN, PROJECT PLANNING COMPLETED MARCH 1962. SPECIFICATIONS HAVE BEEN SUBMITTED TO EURATOM-U.S. JOINT PROGRAM. THE REACTOR, SUPPLIED BY INTERATOM WILL BE BASED ON THE PIQUA, OHIO DESIGN. KBWP IS NEGOTIATING ON A SECOND PLANT WITH AEG/GE AND SIEMENS/WEST.

REFERENCES APPLIED ATOMICS JUNE 13, 1962 P. 1
NEWS RELEASE

PRESSURIZED LIGHT WATER REACTORS
DOMESTIC

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PRESSURIZED LIGHT WATER REACTORS, DOMESTIC

HD01

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NAME/OWNER SM-1 /STATIONARY MEDIUM POWER-1/ DOD
APPR-1

DESIGNER ALCO PRODUCTS INC.

OPERATOR US ARMY

LOCATION FT. BELVOIR, VIRGINIA

PURPOSE PROTOTYPE PACKAGE POWER FOR REMOTE LOCATIONS.

TYPE PWR, PACKAGE POWER

POWER MWE(MWT) 2 10

CRITICAL 1957. CORE 2, 1960, CORE 3, 1964

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE-SS CERMET PLUS BORON COMPOUND

FUEL GEOMETRY PLATE 0.03 IN. THICK
CORE 3, 0.040 IN.

FUEL CLADDING SS 0.005 IN. THICK

FUEL ENRICH. 93 PER CENT U-235

FUEL ASSEMBLY SANDWICH, BRAZED. CORE 3 WELDED.
ACTIVE CORE HEIGHT 22 IN.
38 STATIONARY, 7 MOVABLE PLATES, 7X7 WITH
CORNERS MISSING.
CORE 3, 37 ELEMENTS, 8 DUMMY ELEMENTS, WITH
INCREASED FUEL AND BORON LOADINGS.

FUEL CHARGE 24 KG. URANIUM

SPECIFIC POWER 444 KW/KG U-235

BURNUP(REFUEL) AVE. 33 PER CENT 78 WEEKS

NEUTRON FLUX THERMAL AVE. 2.7×10^{13}
FAST AVE. 1×10^{14}

CONTROL CONTROL-ROD-FUEL-ELEMENT AND MTR TYPE RODS

COOLANT TEMP. OUTLET 450 F

COOLANT PRESS. 1200 PSIA

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REACTOR VESSEL CARBON STEEL 48 IN. ID./64 IN. LONG, SS-CLAD.

CONTAINMENT VAPOR CONTAINER A COMBINATION STEEL AND CONCRETE
STRUCTURE 32 FT. ID./60 FT. HIGH. 7/8 IN. THICK
STEEL CYLINDRICAL OUTER SHELL, INNER OF 2 FT.
THICK REINFORCED CONCRETE LINED WITH LIGHT STEEL
PLATE.

REMARKS REACTOR WILL BE OPERATED FOR THE NEXT FEW YEARS
FOR RESEARCH AND TRAINING.

REFERENCES HAZARDS SUMMARY REPORT FOR THE ARMY PACKAGE POWER
REACTOR SM-1
SS ROSEN, ED.
APAE-2 /1955/

ORNL-S DESIGN FOR A POWER REACTOR PACKAGE.
RS LIVINGSTON, AL BLOCH
NUCLEONICS 13, 24-7 /MAY 1955/

A PACKAGE POWER REACTOR FOR REMOTE LOCATIONS.
AL BLOCH
AECU-3170 /1955/

APPR-1, DESIGN, CONSTRUCTION, AND OPERATION.
APAE-23 /NOVEMBER 1957/

REACTOR ANALYSIS APPR-1, CORE 2
APAE-32 /1958/

PORTABLE NUCLEAR POWER PLANT OFFERS OPERATING
FLEXIBILITY, EASY MAINTENANCE, AND LONG LIFE FOR
REMOTE INDUSTRIAL, MINING, AND MILITARY SITES.
POWER 103, 61-3 /JANUARY 1959/

DESIGN ANALYSIS OF A PREPACKAGED NUCLEAR POWER
PLANT /1000 EKW/.
VOLUME 1, PRIMARY AND SECONDARY SYSTEM DESIGN.
VOLUME 2, REACTOR DESIGN ANALYSIS.
ALCO PRODUCTS INC.

CORE CHARACTERISTICS OF FOUR ARMY PACKAGE POWER
REACTORS.
JG GALLAGHER, OTHERS
NUCLEAR SCI. + ENG, 2 /SUPPLEMENT/. 15-16 /JUNE
1959/

HAZARDS REPORT FOR SM-1, CORE 3
FG MOOTE

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ACNP-64516 /JAN. 1964/

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HD02

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NAME/OWNER SM-1A /STATIONARY MEDIUM POWER-1A/ DOD
APPR-1A

DESIGNER ALCO PRODUCTS INC.

OPERATOR US ARMY

LOCATION FORT GREELY, ALASKA

PURPOSE POWER AND SPACE HEAT

TYPE PAR, PACKAGED POWER

POWER MWE(MWT) 1-6 20

CRITICAL MARCH 1962. CORE 2 DELIVERED NOVEMBER 1962.

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE-SS CERMET, BORON ADDED

FUEL GEOMETRY PLATE 30 MILS THICK
CORE 3, PLATE 0.030 IN. MEAT

FUEL CLADDING SS 0.0050 IN. THICK

FUEL ENRICH. 93 PER CENT U-235

FUEL ASSEMBLY ASSEMBLY OF FUELED PLATES
CORE 3
16 PLATES/ASSEMBLY
7X7 ARRAY OF ASSEMBLIES, CORNER OMITTED
ACTIVE HEIGHT 22 IN.

FUEL CHARGE 22.38 KG. U-235
CORE 3, 36.26 KG. U-235

BURNUP(REFUEL) CORE LIFE 15 MW-YR
CORE 3, LIFETIME 32 MW-YR

NEUTRON FLUX THERMAL 1.94×10^{13} FOR CORE 3

CONTROL FUEL ELEMENTS WITH ABSORBER FOLLOWER AND MTR-TYPE
RODS

COOLANT TEMP. INLET 423 F OUTLET 443 F

COOLANT PRESS. 1200 PSIA

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HD02

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REACTOR VESSEL FIRST PRESSURE VESSEL WAS CARBON STEEL,
WITH CORE 3, SS WILL REPLACE THE CARBON STEEL.
THIS CHANGE WILL ALSO BE MADE FOR PM-1 AND PM-3A

CONTAINMENT VAPOR CONTAINER /ENERGY QUENCH CONTAINMENT/
CONSISTS OF TWO CONCENTRIC CYLINDERS, THE INNER
3 1/2 FT. THICK CONCRETE SEALED AT THE TOP AND THE
OUTER STEEL.

REMARKS SHUT DOWN FOR REFUELING IN MARCH 1964, RE-STARTUP
APRIL 1964.

REFERENCES CHARACTERISTICS OF FOUR ARMY PACKAGE POWER
REACTORS.
JG GALLAGHER, OTHERS
NUCLEAR SCI. AND ENG. /SUPPLEMENT/ 2, 15-16 /JUNE
1959/

THE ARMY NUCLEAR POWER PROGRAM, ITS REACTORS, AND
THEIR APPLICATION TO THE LESS-DEVELOPED AREAS OF
THE WORLD.
JK BRATTON
SYMPOSIUM ON SMALL AND MEDIUM POWER REACTORS,
VIENNA, 1960.
PAPER SMPR-51 /1960/

HAZARDS REPORT - SM-1A CORE 2.
JR COMBE, OTHERS
ACNP-62832 /OCTOBER 18, 1962/

ADDENDUM TO SM-1A HAZARDS SUMMARY REPORT FOR
CORE 3.
HITTMAN ASSOC. INC.
HIT-3534-1 /JUNE 30, 1965/

SEE ALSO SM-1

JANUARY 1967

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD03

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NAME/OWNER PM-2A /PORTABLE MEDIUM POWER 2A/ DOD
SKID-MOUNTED APPR

DESIGNER ALCO PRODUCTS INC.

OPERATOR US ARMY

LOCATION CAMP CENTURY, GREENLAND /IN 1965 NRTS, IDAHO/

PURPOSE POWER AND SPACE HEAT

TYPE PWR, PACKAGED POWER

POWER MWE(MWT) 1.5 10

CRITICAL 1960. TRANSFERRED TO NRTS, RE-STARTUP 1965

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE-SS CERMET, BORON ADDED

FUEL GEOMETRY PLATE 30 MILS THICK

FUEL CLADDING SS 5 MILS THICK

FUEL ENRICH. 93 PERCENT U-235

FUEL ASSEMBLY ASSEMBLY OF FUELED PLATES

FUEL CHARGE 18.49 KG. U-235

BURNUP(REFUEL) CORE LIFE 10MM=YR

COOLANT TEMP. OUTLET 518 F

COOLANT PRESS. 1750 PSIA

CONTAINMENT UNDER-SNOW CONSTRUCTION, VAPOR CONTAINER.

REMARKS THE PLANT WAS DISMANTLED IN JANUARY, 1964, FOR
TRANSFER TO NRTS, IDAHO TO TAKE PART IN AEC-S
REACTOR SAFETY R+D PROGRAM.

REFERENCES HAZARDS SUMMARY REPORT. PREPACKAGED NUCLEAR
POWER PLANT FOR AN ICE-CAP STATION /PM-2A/
EM RIEBACK, OTHERS
APAE-49 /JULY 1959/ AND SUPPLEMENT /APRIL 1960/

HD03

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HD03

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SEE ALSO SM-1

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PRESSURIZED LIGHT WATER REACTORS, DOMESTIC

HD04

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NAME/OWNER	SM-2 /STATIONARY MEDIUM POWER-2/ AEC-DOD APPR-1B
DESIGNER	ALCO PRODUCTS INC.
PURPOSE	POWER FOR NIKE-ZEUS INSTALLATIONS, REMOTE LOCATIONS
TYPE	PWR, PACKAGED POWER
POWER MWE(MWT)	6 28
CRITICAL	DESIGN
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE-SS CERMET, BORON ADDED
FUEL GEOMETRY	PLATE
FUEL CLADDING	SS
FUEL ENRICH.	93 PER CENT U-235
FUEL ASSEMBLY	ASSEMBLY OF FUELED PLATES
FUEL CHARGE	36.2 KG. U-235
BURNUP(REFUEL)	2 CORES/YEAR
CONTROL	FUEL ELEMENTS WITH ABSORBER FOLLOWER AND MTR-TYPE CONTROL RODS
COOLANT TEMP.	OUTLET 525 F
COOLANT PRESS.	2000 PSIA
CONTAINMENT	SEPARATE VAPOR CONTAINMENT FOR EACH REACTOR IN A MULTIPLE-REACTOR COMPLEX, 20 FT. VERTICAL CYLINDER, PARTLY BELOW-GRADE.
REMARKS	COMPLEX OF TWO SEPARATE REACTORS TO PROVIDE 12 MWE FOR SITE POWER, CONSTRUCTION DEPENDS ON DOD REQUIREMENTS.
REFERENCES	CONCEPTUAL DESIGN OF SM-2 12000 EKW POWER COMPLEX, ALCO PRODUCTS APAE-68 /MAY 1960/

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD04

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SM-2 CORE AND VESSEL DESIGN ANALYSIS,
ALCO PRODUCTS
APAE-69 /VOL. 1,2, AND 3/ /MARCH 1961/

SEE ALSO SM-1

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD05

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NAME/OWNER PL-3 /PORTABLE LOW-POWER-3//AEC,DOD
 DESIGNER ALCO PRODUCTS INC.
 LOCATION PROPOSED FOR BYRD STATION, ANTARCTICA
 PURPOSE POWER AND SPACE HEAT FOR ICE-CA² INSTALLATION.
 TYPE PWR, PACKAGED POWER
 POWER MWE(MWT) 1 9.3
 CRITICAL DESIGN. FOR REDESIGN BY AC SEE PM-3B
 COOLANT LIGHT WATER
 MODERATOR LIGHT WATER
 FUEL MATERIAL URANIUM DIOXIDE-SS CERMET, ZIRCONIUM DIBORIDE
 ADDED.
 FUEL GEOMETRY PLATE 21.75 IN. ACT. LENGTH, 2.778 IN. WIDE, 0.030
 IN. THICK
 FUEL CLADDING SS 0.005 IN. THICK
 FUEL ENRICH. 93 PER CENT U-235
 FUEL ASSEMBLY 18-PLATE RECTANGULAR ASSEMBLY PLUS MOVABLE PLATES.
 FUEL CHARGE 22.48 KG U-235
 BURNUP(REFUEL) AVE. 35 PER CENT. 2 YEARS
 NEUTRON FLUX THERMAL AVE 1×10^{13}
 CONTROL MTR-TYPE ROD, FUEL ELEMENT ABSORBER FOLLOWER
 COOLANT TEMP. INLET 454 F OUTLET 487 F
 COOLANT PRESS. 1200 PSIA
 REACTOR VESSEL SS-LINED STEEL VESSEL 40 IN. ID./11 FT, 6 IN. LONG
 CONTAINMENT SNOW TUNNEL, DOUBLE VAPOR CONTAINER COMPOSED OF
 VERTICAL CYLINDERS, ONE CONTAINING THE REACTOR
 VESSEL AND THE OTHER THE STEAM GENERATOR,
 PRESSURIZER, AND PRIMARY PUMP. VESSELS CONNECTED
 BY FLEXIBLE DUCTS.
 REMARKS NEW DESIGNATION IS PM-3B. PHASE I STUDY AND

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HD05

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DESIGN RECOMMENDATION HAS BEEN COMPLETED. AC HAS
DONE A RE-EVALUATION OF ALL WORK DONE ON PM-3B
WITH THE OBJECTIVE OF A NEW DESIGN CONCEPT FOR A
LIGHTER, MORE COMPACT PORTABLE REACTOR OF AT
LEAST 1 MWE POWER RATING.

REFERENCES

PWR PRELIMINARY DESIGN DATA FOR PL-3.
ALCO PRODUCTS
APAE-115 /VOL. 2/ /FEBRUARY 1962/

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NAME/OWNER	PM-3B/PORTABLE MEDIUM-POWER-3B//AEC-DOD REDESIGN OF PL-3	
DESIGNER	ALLIS-CHALMERS MANUFACTURING CO.	
LOCATION	PROPOSED FOR BYRD STATION, ANTARCTICA	
PURPOSE	REDESIGN OF PL-3 FOR ICE CAP STATION /BYRD STATION/	
TYPE	PWR, PACKAGED POWER	
POWER MWE(MWT)	1.5	8.2
CRITICAL	DESIGN, REDESIGN OF PL-3	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE-SS MATRIX	
FUEL GEOMETRY	TUBE 0.506 IN. OD./0.416 IN. ID./ACT. LENGTH 30 IN	
FUEL CLADDING	SS 0.0060 IN. THICK, INNER AND OUTER	
FUEL ENRICH.	93.2 PER CENT U-235	
FUEL ASSEMBLY	129-TUBE BUNDLE 6 FUEL BUNDLES/CORE FUEL BUNDLES CONTAIN CONTROL RODS WITH AN ABSORBER LENGTH OF EUROPIUM/TITANIUM OXIDE IN SS.	
FUEL CHARGE	31.0 KG. U-235	
BURNUP(REFUEL)	CORE LIFE 24.0 MW-YR	
NEUTRON FLUX	THERMAL AVE. 1.16×10^6	
CONTROL	BURNABLE POISON ELEMENT, CONTROL RODS	
COOLANT TEMP.	463 F	
COOLANT PRESS.	1300 PSIA	
REACTOR VESSEL	STEEL PRESSURE VESSEL	
REMARKS	AC HAS EVALUATED ALL WORK DONE ON THE PM-3B /PL-3/ DESIGN.	

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REFERENCES

BYRD STATION STUDY, FINAL REPORT. INCLUDES
ADDENDUM 1.

ALLIS-CHALMERS MANUFACTURING CO.
ACNP-62848 AND ADD. 1 /FEBRUARY 1, 1963/

INLAND ANTARCTIC STATION NUCLEAR POWER PLANT
SUMMARY DESIGN REPORT.

VOL. 2, PRELIMINARY SAFETY ANALYSIS.
ALLIS-CHALMERS MANUFACTURING CO.
ACNP-63809 /VOL. 1-2/ /JULY 1963/

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD07

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NAME/OWNER	INDIAN POINT-1/CONSOLIDATED EDISON	
DESIGNER	BABCOCK AND WILCOX	
OPERATOR	CONSOLIDATED EDISON CO.	
LOCATION	BUCHANAN /INDIAN POINT/ NEW YORK	
PURPOSE	POWER	
TYPE	PWR, THORIUM-URANIUM CONVERTER,	
POWER MWE(MWT)	163	585
	CORE B, 282 MWE AND 615 MWT	
CRITICAL	AUG. 1962, FULL POWER JAN. 1963	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	CORE 1 URANIUM/THORIUM DIOXIDE PELLETS 0.26 IN. DIA./0.78 IN. LONG CORE 2 URANIUM DIOXIDE PELLETS, NO THORIUM	
FUEL GEOMETRY	RODS, ACT. LENGTH 98.5 IN.	
FUEL CLADDING	SS 0.0205 IN. THICK	
FUEL ENRICH.	93 PER CENT U-235, RADIAL. CORE 2 SLIGHT	
FUEL ASSEMBLY	CORE 1, 195-ROD BUNDLE IN ZIRCALOY-2 ASSEMBLY. 120 ASSEMBLIES/CORE CORE 2, 173-ROD ASSEMBLY 120 ASSEMBLIES/CORE	
FUEL CHARGE	1100 KG. U-235 AND 17,200 KG. THORIUM OXIDE	
BURNUP(REFUEL)	22000 MWD/T	BATCH, CENTER 40 ELEMENTS/YEAR WITH CORE B
NEUTRON FLUX	THERMAL AVE. 2×10^{13}	
CONTROL	CONTROL RODS, FIXED SHIMS, SOLUBLE POISON, AND BURNABLE POISON IN THE FUEL CLADDING.	
COOLANT TEMP.	INLET 486 F	OUTLET 570 F
COOLANT PRESS.	1500 PSIA	

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REACTOR VESSEL CARBON STEEL CYLINDER 36 FT. 9 IN. HIGH / 9 FT.
9 IN. ID. AND 6.95 IN. WALL THICKNESS.

CONTAINMENT STEEL SPHERE 160 FT. ID. SURROUNDED BY CONCRETE
STRUCTURE WITH 5 1/2 FT. THICK WALLS AND 2 3/4 FT.
THICK DOMED ROOF.

REMARKS SECOND CORE IS AN ADVANCED 3-REGION DESIGN.
REFUELING COMPLETED MARCH 16, 1966.
CRITICAL APRIL 1, FULL POWER END OF APRIL 1966.

REFERENCES REACTOR STUDIES. FINAL REPORT. PART I.
TID-10117 /1955. DECLASSIFIED MARCH 1957/

THE CONSOLIDATED EDISON THORIUM REACTOR
F WARD
BNL-483 /JANUARY 1958/

CORE DESIGN AND CHARACTERISTICS OF THE
CONSOLIDATED EDISON REACTOR.
BAW-9 /REV.3/ /AUGUST 1958/

THE CONSOLIDATED EDISON COMPANY OF NEW YORK
NUCLEAR ELECTRIC GENERATING STATION.
GR MILNE, OTHERS
SECOND U. N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY 8. 483-9 /1958/

HAZARDS SUMMARY REPORT, CONSOLIDATED EDISON
THORIUM REACTOR.
USAEC DOCKET 50-3, EXHIBIT K-5 /REV. 1/
BABCOCK AND WILCOX CO. /JANUARY 1960/

CONSOLIDATED EDISON THORIUM REACTOR PHYSICS
DESIGN.
HS BARRINGER, OTHERS
BAW-120 /REV.1/ /JULY 1960/

INDIAN POINT -CONSOLIDATED EDISON-S THORIUM
CONVERTER.
NUCLEAR ENG. 6. 413-23 /OCTOBER 1961/

INDIAN POINT ON-THE-LINE.
NUCLEONICS REACTOR FILE NO. 14
NUCLEONICS 21. 45-52 /APRIL 1963/

CONSOLIDATED EDISON NUCLEAR STEAM GENERATING
STATION.
POWER REACTOR TECHNOLOGY 6 /3/. 28-40 /JUNE 1963/

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PRELIMINARY HAZARDS SUMMARY REPORT FOR THE
CONSOLIDATED EDISON INDIAN POINT REACTOR, CORE 3.
CONSOLIDATED EDISON /N.Y./ AND WESTINGHOUSE
ELECTRIC CORPORATION,
NP-12869 /ND/

CONCEPTUAL DESIGN OF CORE B, CONSOLIDATED EDISON
COMPANY,
INDIAN POINT NUCLEAR FACILITY.
WESTINGHOUSE ELECTRIC CORP.,
TID-20964

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD08

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NAME/OWNER	MSR /MERCHANT SHIP REACTOR//AEC-MA N.S. SAVANNAH.	
DESIGNER	BABCOCK AND WILCOX	
OPERATOR	MARITIME ADMINISTRATION, U. S. A.	
LOCATION	LAND-BASED PROTOTYPE AT LYNCHBURG, VA.	
PURPOSE	SHIP PROPULSION, SURFACE.	
TYPE	PWR	
POWER MWE(MWT)	20,000 SHP	70
CRITICAL	FEB. 1960	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.4245 IN. DIA./0.5 IN. LONG	
FUEL GEOMETRY	ROD 66 IN. ACTIVE LENGTH	
FUEL CLADDING	SS TUBES 0.035 IN. WALL THICKNESS	
FUEL ENRICH.	4.2 AND 4.6 PER CENT U-235	
FUEL ASSEMBLY	164-TUBE ELEMENT. TUBES ARE HELD IN A RIGID BUNDLE OF 41 ELEMENTS BY BRAZED SS FERRULES /EGG-CRATE STRUCTURE/ 32 ASSEMBLIES/CORE	
FUEL CHARGE	312.4 KG. U-235	
BURNUP(REFUEL)	7352 MWD/MTU	SEE REMARKS
CONTROL	CRUCIFORM RODS. BORON-SS. TOP-DRIVEN.	
COOLANT TEMP.	INLET 463 F	OUTLET 519 F
COOLANT PRESS.	1750 PSIA	
REACTOR VESSEL	SS-LINED CARBON STEEL CYLINDER 98 IN. ID./26 FT. 10 IN. HIGH.	
CONTAINMENT	SHELL LYING LENGTH-WISE OF SHIP IS A CYLINDER WITH HEMISPHERICAL ENDS, CENTER CUPOLA, 35 FT. DIA.	

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BY 50 1/2 FT. LONG.

REMARKS

N.S. SAVANNAH OPERATION, 1961.
 AS OF JULY, 1966, SAVANNAH CAN CONTINUE TO OPERATE
 ON FIRST CORE FOR 6 MORE YEARS, WITH FUEL
 SHUFFLING AND REPLACEMENT OF FOUR OUT OF THIRTY-
 TWO FUEL ELEMENTS.

REFERENCES

THE POWER PLANT FOR THE FIRST NUCLEAR MERCHANT
 SHIP /N.S. SAVANNAH/.
 J. LANDIS
 TID-7563 /P. 11/ /AUGUST 1958/

NUCLEAR MERCHANT SHIP REACTOR, FINAL SAFEGUARDS
 REPORT, DESCRIPTION OF THE N. S. SAVANNAH.
 GE KULYNCH
 BAW-1164, VOL. I /JUNE 1960/

N.S. SAVANNAH,
 NUCLEAR ENG. 5, 447-51 /OCTOBER 1960/

DESIGN PRACTICE . THE N.S. SAVANNAH.
 POWER REACTOR TECHNOLOGY 6, 43-54
 /DECEMBER 1962/

NUCLEAR PROPULSION FOR MERCHANT SHIPS.
 A. KRAMER
 US. GPO, WASHINGTON, D.C., 1962

LIFETIME STUDIES FOR THE N.S. SAVANNAH REACTOR,
 EE GROSS, OTHERS
 ORNL-3261, SUPPL. /APRIL 1963/

NUCLEONICS WEEK JULY 21, 1966
 NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS, DOMESTIC

HD09

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NAME/OWNER CNSG /CONSOLIDATED NUCLEAR STEAM GENERATOR//BAW
 DESIGNER BABCOCK AND WILCOX
 PURPOSE SHIP PROPULSION
 TYPE PWR, FORCED CIRCULATION, CLOSED CYCLE
 POWER MWE(MWT) 27,500 SHP 62.4
 CRITICAL REFERENCE DESIGN. SEE REMARKS.
 COOLANT LIGHT WATER
 MODERATOR LIGHT WATER
 FUEL MATERIAL URANIUM DIOXIDE PELLETS, COMPACTED
 FUEL GEOMETRY PIN, SWAGED, 0.460 IN. DIA. ACT. LENGTH 42 IN.
 FUEL CLADDING ZIRCALOY-2 0.021 IN. THICK
 FUEL ENRICH. ZONE 1, 2 AND 3, 1.6, 2.1, AND 3.1 PER CENT U-235
 FUEL ASSEMBLY TYPE A, 108-PIN BUNDLE, TOTAL 13 ASSEMBLIES,
 TYPE B, 121-ROD BUNDLE, TOTAL 24 ASSEMBLIES,
 REGION 1, 1 TYPE A ELEMENT /CENTRAL/
 REGION 2, 6 TYPE B ELEMENTS /INNER RING/ PLUS
 RING OF 12 TYPE A ELEMENTS
 REGION 3, 18 TYPE B ELEMENTS /OUTER RING/
 CORE CONTAINER IS A SEGMENTED SS STRUCTURE
 FUEL CHARGE 4100 KG. URANIUM DIOXIDE, 92.85 KG. U-235
 BURNUP(REFUEL) 15,000 MWD/T FUEL SHUFFLING
 URANIUM DIOXIDE
 CONTROL CHEMICAL SHIM, BORIC ACID, CONTROL RODS
 COOLANT TEMP. INLET 490.4 F OUTLET 520 F
 COOLANT PRESS. 816 PSIA
 REACTOR VESSEL STEEL CYLINDER 10 FT. DIA./27 FT. HIGH, OUTER
 8 IN. THICK LEAD CLADDING BONDED TO SHELL. VESSEL
 COMPLETELY SUBMERGED IN WATER. SEE REMARKS.
 CONTAINMENT WATER-FILLED STEEL CYLINDRICAL VESSEL 19 FT. DIA./
 38 FT HIGH. PRESSURE-SUPPRESSION. SEE REMARKS.
 REMARKS THE CONCEPT IS BASED ON MSR AND IBR DESIGNS. IN

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HD09

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REDESIGN STUDIES, CNSG-2 IS A COMPACT SYSTEM USING SOLID IN-CORE BURNABLE POISON, AND HAS WET CONTAINMENT BUT WITH THE WATER IN A WELL. CNSG-3 IS THE MOST ADVANCED DESIGN, WITH STEAM GENERATOR OR HEAT EXCHANGER WITHIN THE REACTOR PRESSURE VESSEL. CORE IS OF ROD OR PIN TYPE WITH URANIUM DIOXIDE PELLETS IN ZIRCALOY TUBES AND 4 ZONES OF ENRICHMENT, AVERAGING ABOUT 5 PER CENT. ACTIVE CONTROL ROD MATERIAL IS A CADMIUM-INDIUM-SILVER ALLOY AND THE BURNABLE POISON ZIRCONIUM DIBORIDE DISPERSED IN ZIRCONIUM OXIDE. CNSG-3 HAS THREE SIZES, 22,000, 44,000 AND 66,000 SHP. WITH ITS GERMAN AFFILIATE DEUTSCHE BABCOCK AND WILCOX, BAW HAS PREPARED A DESIGN BASED ON CNSG-1 WHICH WAS SELECTED FOR GERMANY-S NUCLEAR SHIP. IT DIFFERS ONLY IN THE FACT THAT THE STEAM GENERATOR IS MOVED OUTWARD FROM THE CORE, SUBSTITUTION OF AN IN-CORE BURNABLE POISON FOR CHEMICAL SHIM CONTROL, AND DRY, HOT WET CONTAINMENT. A COMPACT, NATURAL CIRCULATION SYSTEM FOR UNDERWATER SERVICE, CONTROLLED ONLY BY STEAM DEMAND, HAS BEEN DESIGNED.

SEE HD15

REFERENCES

CONSOLIDATED NUCLEAR STEAM GENERATOR FOR MERCHANT SHIP APPLICATION. A CONCEPTUAL DESIGN, BABCOCK + WILCOX CO, BAW-1243 /AUGUST 1962/

CONSOLIDATED NUCLEAR STEAM GENERATOR FOR MARINE APPLICATION, ENGINEER 214. 789-90 /NOVEMBER 2, 1962/

COMPACT MARINE REACTOR, NUCLEAR ENERGY, DECEMBER 1962, P. 465.

CNSG-3, MOST ADVANCED PWR FOR MERCHANT MARINE USE, NUCLEONICS 22. 23-25 /JULY 1964/

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HD10

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NAME/OWNER PALISADES PARK NUCLEAR STATION/CONSUMERS POWER
DESIGNER COMBUSTION ENGINEERING
OPERATOR CONSUMERS POWER CO.
LOCATION PALISADES PARK, MICHIGAN /LAKE MICHIGAN/
PURPOSE POWER
TYPE PWR, 2-LOOP SYSTEM
POWER MWE(MWT) 770 2200
CRITICAL CONTRACT AWARD JAN, 1966. TARGET 1970.
COMMERICAL OPERATION MAY 1970.
COOLANT LIGHT WATER
MODERATOR LIGHT WATER
FUEL MATERIAL URANIUM DIOXIDE
FUEL GEOMETRY ROD, ACT, LENGTH 132 IN.
FUEL CLADDING ZIRCALOY-4
FUEL ENRICH. ZONE
FUEL ASSEMBLY 15X15 ROD BUNDLE.
OPEN TYPE WITH LEAF SPRING SPACERS
204 ASSEMBLIES/CORE
SPECIFIC POWER 24.7 KW/KG URANIUM
BURNUP(REFUEL) 21,607 MWD/MTU 1/3 CORE
CONTROL ROD, BORON CARBIDE-SS, TOP-MOUNTED,
CHEMICAL SHIM /BORIC ACID/
COOLANT TEMP. INLET 545 F OUTLET 591 F
COOLANT PRESS. 2100 PSIA
REACTOR VESSEL STEEL, SS-CLAD VESSEL 172 IN, ID/40 FT, HIGH
CONTAINMENT VAPOR-TIGHT ENVELOPE TYPE,
CONCRETE SILO 240 FT. HIGH/96 FT. ID. WITH
INNER CARBON STEEL LINER,
REMARKS FIRST CORE WILL BE PURCHASED FROM CE UNDER A

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SEPARATE CONTRACT. THE PLANT WILL BECOME PART
OF MICHIGAN POWER POOL INTERCONNECTING CONSUMERS
POWER AND DETROIT EDISON SYSTEMS.

REFERENCES

NUCLEONICS WEEK FEB, 3, 1966 P.1-3
NEWS RELEASE

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HD11

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NAME/OWNER	NUCLEAR TANKER DESIGN STUDY/CE-AEC	
DESIGNER	COMBUSTION ENGINEERING, INC.	
PURPOSE	SHIP PROPULSION	
TYPE	PWR, FORCED CIRCULATION	
POWER MWE(MWT)	30,000 SHP	82
CRITICAL	REFERENCE DESIGN	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.312 IN. DIA./0.468 IN. LONG	
FUEL GEOMETRY	RODS, ACTIVE LENGTH 52 IN.	
FUEL CLADDING	SS TUBES 0.023 IN. WALL THICKNESS	
FUEL ENRICH.	5.4 PER CENT U-235, ZONE ENRICHMENT	
FUEL ASSEMBLY	91-ROD CLUSTER 87 CONTAIN FUEL AND 3 BURNABLE POISON 91 CLUSTERS/CORE. 19 ARE MOVABLE FOR CONTROL.	
FUEL CHARGE	4.424 METRIC TONS URANIUM	
BURNUP(REFUEL)	890 DAYS	
NEUTRON FLUX	THERMAL AVE, 1.7×10^{13}	
CONTROL	NEUTRON RECTIFIER ASSEMBLIES, BURNABLE POISON	
COOLANT TEMP.	INLET 589 F	OUTLET 620 F
COOLANT PRESS.	2000 PSIA	
REACTOR VESSEL	CARBON STEEL, SS LINED, 75 IN. OD./228 IN. LONG. WALL 4.75 IN. THICK.	
CONTAINMENT	VAPOR CONTAINER, STEEL, ENCLOSURES ENTIRE MAIN COOLANT SYSTEM, CYLINDRICAL SHELL, HEMISPHERICAL ENDS, 34 FT. DIA. /52 FT. HIGH.	
REMARKS	DEVELOPMENT OF A REFERENCE CONCEPTUAL DESIGN FOR NUCLEAR CARGO OR TANKER, IN CONJUNCTION WITH	

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GEORGE C. SHARP INC., FOR THE AEC,

REFERENCES

NUCLEAR POWERED TANKER DESIGN AND ECONOMIC
ANALYSIS PRESSURIZED WATER REACTOR,
COMBUSTION ENG. INC.
CEND-62 /1960/
NYO-2860 /1960/

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NAME/OWNER	ADVANCED SHIP REACTOR/CE	
DESIGNER	COMBUSTION ENGINEERING, INC.	
PURPOSE	SHIP PROPULSION	
TYPE	PWR, INDIRECT CYCLE, SELF-PRESSURIZING	
POWER MWE(MWT)	30,000 SHP	79.2
CRITICAL	CONCEPTUAL DESIGN	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.514 IN. DIA.	
FUEL GEOMETRY	ROD 0.594 IN. DIA./60 IN. ACTIVE LENGTH	
FUEL CLADDING	SS TUBE 0.037 IN. WALL THICKNESS	
FUEL ENRICH.	4.3 PER CENT U-235, ZONE /3/ ENRICHMENT	
FUEL ASSEMBLY	58-ROD CLUSTER /FUEL/ 61-ROD CLUSTER /MOVABLE CONTROL/ 61 FUEL CLUSTERS, INCLUDING 12 MOVABLE CONTROL CLUSTERS, IN CORE.	
FUEL CHARGE	6.67 METRIC TONS URANIUM	
BURNUP(REFUEL)	14,100 MWD/MTU	
CONTROL	NEUTRON RECTIFIER ASSEMBLIES, SILVER-INDIUM CADMIUM IN SS	
COOLANT TEMP.	INLET 600 F	OUTLET 642.7 F
COOLANT PRESS.	2100 PSIA	
REACTOR VESSEL	STEEL CYLINDER, SS INNER CLADDING, 90.8 IN. OD, AND 23.4 FT. LONG.	
CONTAINMENT	STEEL CYLINDER, HEMISPHERICAL HEADS, 34 FT. DIA, BY 50 FT. HIGH, CONTAINING ALL MAJOR COMPONENTS OF THE REACTOR SYSTEM. THE VESSEL IS SEALED.	
REMARKS	UP-DATING OF THE NUCLEAR TANKER REFERENCE DESIGN STUDY. A LOW-PRESSURE 1300 PSI SYSTEM WOULD UTILIZE THINNER CLADDING AND LOWER ENRICHMENT FUEL	

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REFERENCES

ADVANCED INDIRECT CYCLE WATER REACTOR STUDIES FOR
MARITIME APPLICATIONS. PART 2, PLANT CONCEPTUAL
STUDIES.
COMBUSTION ENG, INC.
CEND-150 /PT.2/ /1962/

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HD13

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NAME/OWNER UMP /UNIFIED MODULAR PLANT//CE
 DESIGNER COMBUSTION ENGINEERING, INC.
 PURPOSE SHIP PROPULSION
 TYPE PWR, CLOSED CYCLE, MODULAR
 POWER MWE(MWT) 30,000 SHP 80
 CRITICAL DESIGN
 COOLANT LIGHT WATER
 MODERATOR LIGHT WATER
 FUEL MATERIAL URANIUM DIOXIDE
 FUEL GEOMETRY ROD 0.328 IN. OD. OUTSIDE CLADDING,
 ACT. LENGTH 50 IN.
 FUEL CLADDING SS TUBES 0.015 IN. WALL THICKNESS
 FUEL ENRICH. 5.9 PER CENT U-235. ZONE ENRICHMENT
 FUEL ASSEMBLY 127-ROD BUNDLE.
 12 MOVABLE BUNDLES INCLUDE A HOLLOW
 WATER-FILLED NEUTRON ABSORBING SECTION FOR
 COLD SHUT-DOWN. ALL ABSORBER SECTIONS ARE
 OUT OF CORE DURING OPERATION.
 61 BUNDLES/CORE
 36 ARE IN FIRST COOLANT PASS AND 25 IN SECOND,
 OR INNER, COOLANT PASS,
 FUEL CHARGE 3.93 METRIC TONS URANIUM
 BURNUP(REFUEL) 20,000 MWD/MTU
 CONTROL SELF-REGULATED CHANGES IN COOLANT DENSITY, AND
 MOVABLE ELEMENTS FOR COLD SHUT-DOWN.
 COOLANT TEMP. INLET 630/590 F OUTLET 668/636 F
 COOLANT PRESS. 2500/2000 PSI
 REACTOR VESSEL STEEL VESSEL 71 IN. ID./22 FT. 4 IN. HIGH. HEAT
 EXCHANGER IS WITHIN THE PRESSURE VESSEL. WATER
 TIGHT CANNING SURROUNDS THE VESSEL, CIRCULATING
 PUMPS, AND COLD SHUT-DOWN MECHANISMS.
 CONTAINMENT VAPOR SUPPRESSION. VESSEL 16 FT. ID./34 FT. LONG

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OF 1 1/2 IN. THICK STEEL. CONTAINMENT VESSEL COMPLETELY ENCAPSULATES THE REACTOR VESSEL AND ITS SHIELDING. SPACE BETWEEN THE CANNED REACTOR ASSEMBLY AND CONTAINMENT VESSEL WALL IS FILLED WITH BORATED WATER TO ABOVE REACTOR VESSEL HEAD.

REMARKS

TWO COOLANT PASSES, PERIPHERAL AND INNER, ARE UPWARD. RADIAL POWER FLATTENING IN THE CORE IS ACHIEVED BY THE USE OF TWO ENRICHMENT ZONES, AND BURNABLE POISON IS USED TO MINIMIZE THE LIFETIME REACTIVITY VARIATION.

REFERENCES

THE UNIFIED MODULAR PLANT, A COMPACT NUCLEAR STEAM GENERATOR FOR MARINE APPLICATION,
PC SMOLA, OTHERS
CEND-169 /DEC. 1963/

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HD14

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NAME/OWNER	ELPHR /EXPERIMENTAL LOW-TEMPERATURE PROCESS HEAT REACTOR//AEC	
DESIGNER	ALLIS-CHALMERS, SARGENT + LUNDY	
LOCATION	PORT LOMA, CALIFORNIA-PROPOSED	
PURPOSE	WATER DESALINIZATION	
TYPE	PWR, CLOSED CYCLE	
POWER MWE(MWT)	0	40
CRITICAL	DESIGN STUDY	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	ROD 0.4 - 0.5 IN. DIA.	
FUEL CLADDING	SS 0.015 - 0.020 IN. THICK	
FUEL ENRICH.	3-4.1 PER CENT U-235	
FUEL ASSEMBLY	SEE REMARKS	
FUEL CHARGE	2970-3440 KG. URANIUM	
BURNUP(REFUEL)	6388-14,600 MWT/T	
CONTROL	RODS, BURNABLE POISON	
COOLANT TEMP.	INLET 400-412 F	OUTLET 429-454 F
COOLANT PRESS.	895-917 PSIA	
REACTOR VESSEL	STEEL VESSEL	
REMARKS	FLUOR CORP. EVALUATED AND COMPARED THE VARIOUS PROPOSALS FOR A SALT WATER DISTILLATION AUXILIARY REACTOR SYSTEM FOR CONSTRUCTION AT POINT LOMA, CALIFORNIA. THE PROJECT HAS BEEN POST-PONED.	
REFERENCES	COMPARISON AND EVALUATION OF REACTOR PACKAGE PROPOSALS. EXPERIMENTAL LOW TEMPERATURE PROCESS HEAT REACTOR PROJECT.	

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EH HYKAN, RA JOHNSON
SL-1767 /DECEMBER 1959/

EXPERIMENTAL LOW-TEMPERATURE PROCESS HEAT REACTOR
PROJECT,
CONTRACT TERMINATION REPORT,
SARGENT + LINDY, ALLIS-CHALMERS MNFG. CO.
TID-12385 /FEB, 24, 1961/

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HD15

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NAME/OWNER COMPACT UNDERWATER PWR/CE
 NATURAL CIRCULATION CNSG

DESIGNER COMBUSTION ENGINEERING

PURPOSE UNDERWATER SERVICE

TYPE PWR, NATURAL CIRCULATION

POWER MWE(MWT) 1000-7000 SHP 8 AND 16 MWT VERSIONS

CRITICAL DESIGN

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

CONTROL BY STEAM DEMAND. NO CONTROL RODS.

REACTOR VESSEL SINGLE PRESSURE VESSEL ENCLOSURES ENTIRE
 PRIMARY SYSTEM,

REFERENCES COMPACT, DEMAND-CONTROLLED, WATER-COOLED NUCLEAR
 REACTORS FOR UNDERWATER SERVICE,
 COMBUSTION ENG. INC.
 AIAA PREPRINT 65-572
 CONF-650610-7

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NAME/OWNER PELICAN POINT PLANT, NUCLEAR ISLAND/MWD, CALIF.

DESIGNER BECHTEL CORP.-FEASIBILITY STUDY.

LOCATION PELICAN POINT /HUNTINGDON/, CALIF.
ARTIFICIAL ISLAND

PURPOSE POWER AND WATER DESALINATION

TYPE PWR, TWIN REACTORS /OR BWR PLANTS/

POWER MWE(MWT) 900 3080 PER REACTOR

CRITICAL TARGET EARLY 1970-S.

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL CLADDING ZIRCONIUM

FUEL ENRICH. SLIGHT

CONTAINMENT REINFORCED CONCRETE CYLINDER FOR EACH REACTOR
137 FT. ID/90 FT. HIGH, 5.5 FT. THICK.

REMARKS THE NUCLEAR ISLAND STUDY INCLUDED A 150 MGD
MULTISTAGE FLASH DISTILLATION PLANT AND TWO LARGE
PWR OR BWR SYSTEMS. METROPOLITAN WATER DISTRICT
AND ELECTRICAL UTILITIES HAVE PROPOSED
CONSTRUCTION OF AN 1800 MWE PLANT AT PELICAN
POINT, CALIF.
CONSTRUCTION HAS BEEN APPROVED BY THE METROPOLITAN
WATER DISTRICT OF S. CALIF. MEMBER UTILITIES ARE
S. CALIF. EDISON, SAN DIEGO GAS AND ELECTRIC, AND
LOS ANGELES DEPT. OF WATER AND POWER.

REFERENCES ENGINEERING AND ECONOMIC FEASIBILITY STUDY FOR A
COMBINATION NUCLEAR POWER AND DESALTING PLANT.
SUMMARY
TID-22330 VOL. 3 /JAN. 1966/
PREPARED BY BECHTEL CORP.

NUCLEONICS WEEK AUG. 11, 1966 P. 1
NEWS RELEASE

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NAME/OWNER	ONCE-THROUGH PWR/BAW
DESIGNER	BABCOCK AND WILCOX
PURPOSE	POWER
TYPE	PWR, ONCE-THROUGH STEAM-GENERATOR, TWO-LOOP SYSTEM
POWER MWE(MWT)	750 2300
CRITICAL	DESIGN
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE
FUEL GEOMETRY	PINS
FUEL CLADDING	ZIRCALOY-4
FUEL ENRICH.	2.55 PER CENT U-235, AVE.
FUEL ASSEMBLY	177 ASSEMBLIES/CORE
CONTROL	SILVER-INDIUM-CADMIUM RODS
COOLANT TEMP.	565.5 F
COOLANT PRESS.	2185.0 PSIG
REMARKS	PRELIMINARY SAFETY REVIEW BY AEC REQUESTED
REFERENCES	NUCLEAR INDUSTRY JAN. 1966 P. 9 NEWS RELEASE

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NAME/OWNER	ISRAELI PLANT STUDY/US-ISRAEL JOINT BOARD PWR	
DESIGNER	KAISER ENG./CATALYTIC CONSTRUCTION	
LOCATION	NITZANIM OR NAHAL SOREQ /NEVE RUBIN/, ISRAEL PREFERRED SITE NITZAMIN, NEAR ASHDOD.	
PURPOSE	POWER AND DESALINATION	
TYPE	PWR, INDIRECT CYCLE, 2-LOOP SYSTEM.	
POWER MWE(MWT)	200	1500
CRITICAL	ENGINEERING, ECONOMIC FEASIBILITY STUDY.	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	RODS	
FUEL CLADDING	ZIRCALOY TUBES /THIN/	
FUEL ASSEMBLY	3 CONCENTRIC CORE REGIONS	
CONTAINMENT	STEEL SPHERE OR CONCRETE CYLINDER, PRESSURE-TIGHT REINFORCED CONCRETE, INNER STEEL LINER, PRESTRESSED CONCRETE, STEEL LINER.	
REMARKS	DESALTING PLANT CAPACITY IS 100 MGD. PLANT CONSISTS OF THE REACTOR, TURBINE GENERATOR, FOUR MULTISTAGE FLASH EVAPORATOR UNITS. A REFERENCE BWR PLANT IS ALSO CONSIDERED. FUEL IS MODULAR, 7X7 ROD BUNDLE IN ZIRCALOY-4 CHANNEL, FUEL PELLETS OF URANIUM DIOXIDE IN ZIRCALOY-2 CLAD RODS.	
REFERENCES	ENGINEERING FEASIBILITY AND ECONOMIC STUDY FOR DUAL-PURPOSE POWER-WATER DESALTING PLANT. KAISER ENG., CATALYTIC CONSTRUCTION CO. REPORT NO. 66-1-RE /JAN. 1966/	

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NAME/OWNER	N-REACTOR/AEC	
DESIGNER	GENERAL ELECTRIC COMPANY	
OPERATOR	GENERAL ELECTRIC COMPANY	
LOCATION	RICHLAND, WASHINGTON	
PURPOSE	PLUTONIUM AND POWER PRODUCTION.	
TYPE	PWR, PRESSURE TUBE	
POWER MWE(MWT)	800	4000 POWER-ONLY OPERATION
CRITICAL	DEC. 1963 POWER OPERATION APRIL 1966 FULL POWER DECEMBER 1966	
COOLANT	LIGHT WATER	
MODERATOR	GRAPHITE	
FUEL MATERIAL	URANIUM METAL, FOR PHASE 3, URANIUM DIOXIDE	
FUEL GEOMETRY	RODS, CO-EXTRUDED	
FUEL CLADDING	ZIRCALOY-2	
COOLANT TEMP.	INLET 469 F	OUTLET 572 F
CONTAINMENT	SEPARATE BUILDINGS FOR REACTOR AND HEAT EXCHANGERS CONFINEMENT-VOLUME WALLS ARE REINFORCED CONCRETE COATED WITH AN ELASTOMER. FOG-SPRAY SYSTEM AND VENT STACKS /PRESSURE-RELEASE/.	
REMARKS	WASHINGTON PUBLIC POWER SUPPLY SYSTEM WILL BUILD THE ELECTRIC GENERATING EQUIPMENT. TARGET DATE FOR OPERATION OF THE GENERATORS IS OCTOBER 1965 /1ST/ AND DECEMBER 1965 /2ND/. A PRESSURE-RELEASE CONTAINMENT SYSTEM IS USED. ELECTRICITY GENERATION IN APRIL, 1966, WITH FIRST TURBINE ON-LINE AT 200 MW. THE POWER PLANT BEING CONSTRUCTED BY WPPSS WILL BE 800 MW CAPACITY.	
REFERENCES	THE NEW PRODUCTION REACTOR, HW-SA-1755 /1959/ UTILITY PROPOSAL FOR POWER PLANT ADDITION TO	

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HANFORD NEW PRODUCTION REACTOR,
UNITED STATES CONGRESS JOINT COMMITTEE ON ATOMIC
ENERGY. /JULY 1962/

BASIS OF DESIGN. HANFORD NEW PRODUCTION REACTOR
/NPR/.

WJ DOWIS
HW-SA-2981 /APRIL 19, 1963/

NUCLEONICS WEEK APRIL 21, 1966
NEWS RELEASE

ANNUAL REPORT TO CONGRESS OF THE ATOMIC ENERGY
COMMISSION FOR 1965. /JAN. 1966/ P. 76-77

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HD20

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NAME/OWNER	PROCESS STEAM REACTOR/MARTIN	
DESIGNER	MARTIN-MARIETTA CORPORATION	
PURPOSE	PROCESS STEAM	
TYPE	PWR	
POWER MWE(MWT)	0	45
CRITICAL	CONCEPTUAL DESIGN	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLET 0.252 IN. DIA.	
FUEL GEOMETRY	ROD 0.280 IN. OD./4.5 FT. LONG	
FUEL CLADDING	ALUMINUM ALLOY 0.012 IN. THICK /LEAD-BISMUTH BOND/	
FUEL ENRICH.	2.5 PER CENT U-235	
FUEL ASSEMBLY	19 BUNDLES CONTAINING 7250 RODS	
FUEL CHARGE	3437 KG. URANIUM DIOXIDE	
COOLANT TEMP.	INLET 376 F	OUTLET 430 F
COOLANT PRESS.	890 PSIA	
REACTOR VESSEL	SS-LINED CARBON STEEL VESSEL 14 FT. 5 IN. HIGH 52 IN. ID. CYLINDER WITH HEMISPHERICAL ENDS.	
CONTAINMENT	ALUMINUM-LINED CONCRETE PIT FILLED WITH WATER, STEEL CONTAINMENT VESSEL.	
REMARKS	COOLANT ENTERS AT BOTTOM OF CORE, FLOWS UPWARD THROUGH OUTER 12 FUEL-ROD BUNDLES, DOWNWARD THROUGH ANNULUS BETWEEN PRESSURE VESSEL WALL AND INNER-MOST THERMAL SHIELD. ON SECOND PASS COOLANT FLOW IS THROUGH CENTRAL OF FUEL-ROD BUNDLES AND OUT OF PRESSURE VESSEL. MICHIGAN CHEMICAL CO. HAD PLANNED AN INSTALLATION. NO RECENT INFORMATION.	
REFERENCES	CONCEPTUAL DESIGN FOR A PROCESS STEAM REACTOR, C EICHELDINGER, OTHERS MND-RP-558-17 /JUNE 1958/	

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NAME/OWNER	PM-1 /PORTABLE MEDIUM-POWER-1/DOD SUNDANCE	
DESIGNER	MARTIN-MARIETTA CORPORATION	
OPERATOR	MARTIN-MARIETTA CORPORATION	
LOCATION	SUNDANCE, WYOMING	
PURPOSE	POWER AND SPACE HEAT	
TYPE	PWR, PACKAGED REACTOR	
POWER MWE(MWT)	1	9.3
CRITICAL	FEB. 1962	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE-SS CERMET 0.0285 IN. MEAT THICKNESS	
FUEL GEOMETRY	TUBE 0.506 IN. OD./0.417 IN. ID./30 IN. ACT. LENGTH	
FUEL CLADDING	SS 0.0085 IN. THICK, INNER AND OUTER	
FUEL ENRICH.	93.3 PER CENT U-235	
FUEL ASSEMBLY	121-ROD BUNDLE /PERIPHERAL/ 15-ROD BUNDLE /CENTRAL/ BUNDLES INCLUDE FUEL, POISON, AND DUMMY ELEMENTS, 741 RODS/CORE 6 PERIPHERAL BUNDLES AND 1 CENTRAL	
FUEL CHARGE	29.14 KG. U-235	
BURNUP(REFUEL)	9 KG. U-235	2 YEARS
NEUTRON FLUX	THERMAL AVE. 1×10^{13}	
CONTROL	CONTROL RODS WITH EUROPIUM TITANATE AS ABSORBER MATERIAL. LUMPED BURNABLE POISON ELEMENTS, PARTIAL AND FULL LENGTH	
COOLANT TEMP.	463 F	
COOLANT PRESS.	1300 PSIA	

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REACTOR VESSEL SS VESSEL 9.3 FT. HIGH/35 IN. ID.

CONTAINMENT PRIMARY SYSTEM UNCONTAINED. UNDERGROUND
CONSTRUCTION.

REMARKS BURNS AND ROE IS DEVELOPING A STANDARDIZED
PORTABLE NUCLEAR PLANT BASED ON THE SUNDANCE AND
MC-MURDO REACTORS. CORE 3 DEVELOPMENT BY MARTIN
CONSISTS OF TUBULAR SS CERMET ELEMENTS, BORON
CARBIDE-ZIRCALOY PELLET-IN-TUBE LUMPED BURNABLE
POISON ELEMENTS, AND PELLET-IN-TUBE FINGER-TYPE
CONTROL ELEMENTS. MAX. POWER WILL BE 30 MWT.
CORE IS INTENDED FOR REPLACEMENT OF PM-1 AND PM-3
CORES AND LATER PLANTS.

REFERENCES

PM-1 NUCLEAR DESIGN ANALYSIS.
EA SCIECHITANO, RA HOFFMEISTER
MND-C-2487 /P. 25-55/ /1961/

PM-1 NUCLEAR POWER PLANT, ADDENDUM TO HAZARDS
SUMMARY EVALUATION.
W HAASS, J SIEG
MND-C-1853 /ADD. 1/ /FEBRUARY 1961/

PM-1 REACTOR CORE FINAL DESIGN REPORT,
RD BAGLEY, OTHERS
MND-M-1866 /JAN. 1962/

REACTOR FILE NO. 12. PM-1 ON-THE-LINE,
NUCLEONICS 20. 37-42 /SEPTEMBER 1962/

PM-1 CORE DESIGN
POWER REACTOR TECHNOLOGY 6 /3/. 43-46 /JUNE 1963/

PM RESEARCH AND DEVELOPMENT PROGRAM.
PM CORE 3 PARAMETRIC STUDY.
R LIGHTNER, OTHERS
MND-MD-2544 /OCT. 1963/

JANUARY 1967

BNWL-326

PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD22

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NAME/OWNER PM-3A /PORTABLE MEDIUM-POWER-3A//DOD
MCMURDO SOUND, ANTARCTIC

DESIGNER MARTIN-MARIETTA CORPORATION

OPERATOR MARTIN-MARIETTA CORPORATION

LOCATION MC MURDO SOUND, ANTARCTICA

PURPOSE	POWER AND SPACE HEAT.
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TYPE PWR, PACKAGED REACTOR

POWER MWE (MWT)	1.5	9.3
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CRITICAL MARCH 1962, REFUELING JANUARY 1965

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE-SS CERMET

FUEL GEOMETRY TUBE 0.506 IN. OD./0.417 IN. ID./30 IN. ACT. LENGTH

FUEL CLADDING SS 0.0085 IN. THICK, INNER AND OUTER

FUEL ENRICH. 93.3 PER CENT U-235

FUEL ASSEMBLY 121-ROD BUNDLE /PERIPHERAL/
15-ROD BUNDLE /CENTRAL/
1 CENTRAL BUNDLE
6 PERIPHERAL BUNDLES
BUNDLES INCLUDE POISON AND DUMMY ELEMENTS.

FUEL CHARGE 29.14 KG. U-235

NEUTRON FLUX THERMAL AVE. 1×10^{13}

CONTROL BURNABLE POISON ELEMENTS, UNCLAD BORON-SS
CYLINDERS, Y-SHAPED SS CLAD CERMET OF EUROPIUM-SS
CONTROL ELEMENT

COOLANT TEMP. 463 F

COOLANT PRESS. 1300 PSIA

REACTOR VESSEL SS CYLINDRICAL VESSEL

REMARKS INSTALLATION DECEMBER 1961 AT BASE, AND STARTUP

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IN MARCH, 1962, CORE DESIGN FOR REPLACEMENT HAS BEEN DEVELOPED BY MARTIN. SEE PM-1. DISTILLATION PLANT OPERATED BY STEAM FROM THE REACTOR WAS TESTED SUCCESSFULLY IN FEB. 1966. THE PLANT WILL BEGIN FULL-TIME OPERATION IN FALL OF 1966. EVAPORATOR PLANT CAN PRODUCE 11 GAL. FRESH WATER PER MINUTE AND STORE 55,000 GAL.

REFERENCES

MARTIN DESIGN REPORT-ICE CAP NUCLEAR POWER PLANT. VOL. 1 AND 2.

RJ AKIN

MND-MPR-1581 /VOL 1 AND 2/ /1959/

THE PM-3A ANTARCTIC REACTOR.

U.S. AEC, U.S. NAVY

BROCHURE, DISTRIBUTED 1961.

PM-3A NUCLEAR POWER PLANT HAZARDS SUMMARY REPORT, SAFETY EVALUATION.

T DOBRY

MND-M3A-2496-2 /ADD/ /NOVEMBER 1951/

OCEAN SCIENCE NEWS MARCH 4, 1966 P. 3
NEWS RELEASE

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NAME/OWNER FBR /FLUIDIZED BED REACTOR//AEC

DESIGNER MARTIN-MARIETTA CORPORATION

OPERATOR CRITICAL EXPERIMENT-MARTIN

LOCATION CRITICAL EXPERIMENT, MIDDLE RIVER, MD.

PURPOSE POWER EXPERIMENT

TYPE PWR, FLUIDIZED BED

POWER MWE(MWT) 100 400

CRITICAL FEASIBILITY STUDY, CRITICAL EXPERIMENT,
SEE REMARKS.

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE CYLINDRICAL PELLETS 205 MILS DIA.

FUEL GEOMETRY PEBBLES /CYLINDERS/

FUEL CLADDING UNCLAD OR COATED. SEE REMARKS

FUEL ENRICH. 1.6 PER CENT U-235

FUEL ASSEMBLY FLUIDIZED BED OF FUEL PEBBLES.

COOLANT TEMP. 550 F

REACTOR VESSEL CYLINDRICAL TANK WITH RESTRAINING SCREENS ACROSS
EACH END.

REMARKS THE UNCLAD FUEL PELLETS ARE PLACED IN THE TANK AND WATER IS PUMPED IN FROM THE BOTTOM. VELOCITY OF THE FLOW SUSPENDS THE PELLETS. PELLETS WERE PREPARED BY COLD COMPACTING FOLLOWED BY SINTERING, OR BY THE CAPILLARY-DROP METHOD. EXPERIMENTAL THIN NICKEL CLADDING BY THE ELECTROLESS NICKEL PLATING METHOD WAS INVESTIGATED. CRITICAL EXPERIMENT FAILED TO GO CRITICAL AFTER FULL LOADING IN APRIL, 1962 BECAUSE OF ABRASION OF THE UNCLAD FUEL. 4 PER CENT ENRICHED PELLETS WERE ADDED TO THE REPLACEMENT FUEL. PROPOSAL FOR REDESIGNED FUEL ELEMENTS SPECIFIED URANIUM MOLYBDENUM ALLOY PELLETS ENRICHED TO 6 PER CENT AND COATED WITH SS, NIOBIUM OR ALUMINUM. STUDIES

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ARE ALSO BEING DONE ON ORGANIC LIQUIDS AS COOLANT
AND MODERATOR.

REFERENCES

FLUIDIZED BED REACTOR STUDY,
CL TEETER, OTHERS.
CF-57-8-14 /1957/

FLUIDIZED BED REACTOR STUDY, PHASE I-FEASIBILITY,
MR SCHEVE
MND-FBR-1696 /FEBRUARY 1959/

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD24

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NAME/OWNER MH-1A /MOBILE HIGH-POWER 1A//DOD
DESIGNER MARTIN-MARIETTA CORPORATION
OPERATOR US ARMY
LOCATION TEST INSTALLATION FT. BELVOIR, VA.
PURPOSE EMERGENCY POWER FOR MILITARY INSTALLATIONS,
COASTAL CITIES, BARGE-MOUNTED.
TYPE PWR, BARGE-MOUNTED
POWER MWE(MWT) 10 45
SEE REMARKS
CRITICAL SHIP INSTALLATION 1966
COOLANT LIGHT WATER
MODERATOR LIGHT WATER
FUEL MATERIAL URANIUM DIOXIDE PELLETS 0.4565 IN. DIA.
FUEL GEOMETRY ROD, ACTIVE LENGTH 36 IN.
FUEL CLADDING SS TUBES WITH BORON ADDED, 0.023 IN. WALL
THICKNESS
FUEL ENRICH. ZONE ENRICHMENT. OUTER 5.4 AND INNER 5.0 PER CENT
U-235
FUEL ASSEMBLY 104-ROD BUNDLE
32 BUNDLES/CORE WITH 12 INTERSPACED CONTROL
RODS
BURNUP(REFUEL) FUEL SHUFFLING
CONTROL RODS, BORON-10 AND SS
COOLANT TEMP. 490 F
COOLANT PRESS. 1600 PSI
REACTOR VESSEL SS-LINED STEEL VESSEL 80 IN. ID.
REMARKS THE REACTOR HOUSING IS A HULL SECTION THAT
REPLACED THE MID-BODY OF A WORLD WAR-2 LIBERTY
SHIP CHARLES H. CUGLE, RENAMED STURGIS, THE PLANT
WILL BE AVAILABLE TO BE TOWED TO ANY PORT FOR

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MILITARY OPERATIONS OR IN DISASTER AREAS.
REACTOR OUTPUT IS 10 MWE AT 60 CYCLES, OR 8083 KW
AT 50 CYCLES.
PROVISION FOR A DESALINATION PLANT IS INCLUDED.

REFERENCES

THE ARMY NUCLEAR POWER PROGRAM, ITS REACTORS, AND
THEIR APPLICATION TO THE LESS-DEVELOPED AREAS OF
THE WORLD.
SYMPOSIUM ON SMALL AND MEDIUM POWER REACTORS.
VIENNA, 1960.
PAPER SMPR-51 /VIENNA, 1960/

MECHANICAL DESIGN OF THE MH-1A REACTORS,
R PICKERING
AMERICAN NUCLEAR SOC. TRANS. 5/2/, 439-40
/NOV. 1962/

DESCRIPTION, APPLICATION, AND SITING OF THE
STURGIS /MH-1A/ FLOATING NUCLEAR POWER PLANT,
RM BUNKER
TRANS. AMERICAN NUCLEAR SOC. 8, 152 /JUNE 1965/

NUCLEONICS WEEK APRIL 21, 1966
NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

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NAME/OWNER BROOKWOOD NUCLEAR STATION/ROCHESTER GAS/ELECTRIC
 GINNA STATION

DESIGNER WESTINGHOUSE ELECTRIC CORP.

OPERATOR ROCHESTER GAS + ELECTRIC CO.

LOCATION BROOKWOOD, LAKE ONTARIO, N.Y.

PURPOSE POWER

TYPE PWR

POWER MWE(MWT) 450

CRITICAL TARGET JUNE 1969

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

REMARKS CONTRACT AWARD SEPT. 1965

REFERENCES NEWS RELEASES

BROOKWOOD NUCLEAR STATION UNIT NO. 1
PRELIMINARY FACILITY DESCRIPTION AND SAFETY
ANALYSIS REPORT.
ROCHESTER GAS AND ELECTRIC CO.
NP-15908 VOL. 1 /ND/

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD26

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NAME/OWNER	INDIAN POINT-2/CONSOLIDATED EDISON	
DESIGNER	WESTINGHOUSE ELECTRIC CORP.	
OPERATOR	CONSOLIDATED EDISON CO.	
LOCATION	INDIAN POINT, N.Y.	
PURPOSE	POWER	
TYPE	PWR, 4-LOOP SYSTEM	
POWER MWE(MWT)	873	2758
CRITICAL	TARGET SPRING 1969	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE	
FUEL GEOMETRY	RODS 0.422 IN. OD., ACT. LENGTH 144 IN.	
FUEL CLADDING	ZIRCALOY, 0.0243 IN. THICK	
FUEL ENRICH.	REGIONAL 2.23, 2.38, 2.68 PER CENT U-235	
FUEL ASSEMBLY	204-ROD CLUSTER 193 ASSEMBLIES 39,372 RODS/CORE	
FUEL CHARGE	215,319 POUNDS URANIUM DIOXIDE	
BURNUP(REFUEL)	12,000 MWD/MTU	
CONTROL	ROD-CLUSTER CONTROL, UNCANNED ASSEMBLIES. CHEMICAL SHIM	
COOLANT TEMP.	INLET 543 F	OUTLET 596 F
COOLANT PRESS.	OPERATING PRESSURE 2235 PSIG.	
REACTOR VESSEL	173-IN. ID./42 FT. 4 IN. HIGH, CLAD SS CLAD 5/32 IN. THICK	
CONTAINMENT	REINFORCED CONCRETE CYLINDRICAL STRUCTURE, STEEL LINER. SPRAY SYSTEM AND AIR RECIRCULATION SYSTEM.	
REMARKS	SITE ADJACENT TO INDIAN POINT-1 SELECTED	

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REFERENCES

INDIAN POINT NUCLEAR GENERATING UNIT NO. 2,
PRELIMINARY SAFETY ANALYSIS REPORT,
PLANT DESIGN DESCRIPTION AND SAFETY ANALYSIS,
CONSOLIDATED EDISON CO.,
NP-16181 /EXHIBIT B/, VOL. 2, PARTS A-B /1965/

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

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NAME/OWNER SHIPPINGPORT ATOMIC POWER STATION/AEC-DUQUESNE

DESIGNER WESTINGHOUSE ELECTRIC CORPORATION

OPERATOR DUQUESNE LIGHT COMPANY

LOCATION SHIPPINGPORT, PA.

PURPOSE POWER DEMONSTRATION

TYPE PWR, SEED AND BLANKET

POWER MWE(MWT) 60 231 /CORE 1/
150 525 /CORE 2/

CRITICAL 1957. SEE REMARKS

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL CORE, URANIUM-ZIRCONIUM
CORE 2, URANIUM/ZIRCONIUM OXIDE
BLANKET, URANIUM DIOXIDE PELLETS

FUEL GEOMETRY CORE, PLATES /SANDWICH/
CORE 2, COMPARTMENTED PLATES

FUEL CLADDING CORE, ZIRCALOY-2 0.015 IN. THICK
CORE 2 ZIRCALOY-4
BLANKET, ZIRCALOY-2 TUBES 0.027 IN. WALL THICKNESS
CORE 2, COMPARTMENTED PLATES

FUEL ENRICH. CORE 92.3 PER CENT U-235
BLANKET NATURAL

FUEL ASSEMBLY CORE, 15-PLATE ASSEMBLY, 4 ASSEMBLIES JOINED IN A
CLUSTER
BLANKET, 120-ROD BUNDLE, 7 BUNDLES STACKED
END-TO-END.
CORE HEIGHT 6 FT.
32 SEED CLUSTERS 5.6 IN./5.6 IN.
113 BLANKET ASSEMBLIES 5.5 IN./5.5 IN.
CORE 2, 20 SEED CLUSTERS 7.376 IN./7.376 IN.
77 BLANKET ASSEMBLIES 7.376 IN./7.40 IN.
CORE HEIGHT 8 FT.

FUEL CHARGE NATURAL URANIUM FUEL 14.16 TONS, ENR, FUEL 165 LBS

SPECIFIC POWER CORE 360 KW/KG U-235

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BLANKET 2.75 KW/KG URANIUM

BURNUP(REFUEL) SEE REMARKS

NEUTRON FLUX THERMAL AVE. CORE 6X10 E+13
 THERMAL AVE. BLANKET 4X10 E+13
 FAST AVE. CORE 2X10 E+14
 FAST AVE. BLANKET 1X10 E+14

CONTROL RODS AND LUMPED BURNABLE POISON IN SEED

COOLANT TEMP. INLET 508 F OUTLET 538 F

COOLANT PRESS. 2000 PSIA

REACTOR VESSEL CARBON STEEL CYLINDER, SS LINED, 31 FT./9 FT. ID.
 VESSEL WALLS 8 IN. THICK

CONTAINMENT INTERCONNECTING STEEL CONTAINERS 50 FT. DIA. BY
 100-135 FT. LONG. CONTAINERS SURROUNDED BY 5-7 FT.
 THICK CONCRETE AND BURIED IN EARTH TO ABOUT 3/4 OF
 HEIGHT

REMARKS SEED 2 WAS INSTALLED IN 1960 AFTER OPERATION OF
 5806 FULL POWER HOURS. 32 ENRICHED SEED ELEMENTS
 AS PARTIAL SEED 3 WERE INSTALLED IN 1962, AND SEED
 4 IN NOVEMBER 1962. REACTOR WAS SHUT DOWN IN NOV.
 1964 FOR INSTALLATION OF SECOND CORE AND
 MODIFICATIONS FOR 150 MWE OPERATION. CORE 2 SEED
 WILL BE ANNULAR WITH 20 HIGHLY-ENRICHED FUEL
 CLUSTERS AND 77 BLANKET CLUSTERS. OPERATIONAL
 TARGET OF JANUARY 1965 HAS BEEN DELAYED ABOUT
 3 MONTHS FOR REDESIGN OF HEAT EXCHANGER SUPPORT
 STRUCTURES. FOUR CONCEPTUAL DESIGNS HAVE EVOLVED
 FROM SHIPPINGPORT.

1. URANIUM CONVERTER-BURNER CORE
2. URANIUM CONVERTER, RECYCLE CORE
3. THORIUM CONVERTER-BURNER CORE
4. THORIUM CONVERTER, RECYCLE CORE.

REFERENCES PROGRESS IN NUCLEAR ENERGY, SERIES II, REACTORS,
 RA CHARPIE, OTHERS
 MC GRAW-HILL BOOK CO., NEW YORK /1956/

SHIPPINGPORT PRESSURIZED WATER REACTOR,
 AEC
 ADDISON-WESLEY. 1958.

SHIPPINGPORT STATION - A PIONEERING PROJECT IN
 ATOMIC POWER.

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WESTINGHOUSE ENG. ISSUE. MARCH 1958.

OPERATING EXPERIENCE. SHIPPINGPORT.

POWER REACTOR TECHNOLOGY 5, 61-72 /SEPTEMBER 1962/

SHIPPINGPORT ATOMIC POWER STATION OPERATING
EXPERIENCE, DEVELOPMENTS, AND FUTURE PLANS.

JT STEIFEL, OTHERS

WAPD-TM-390 /APRIL 1963/

SPECIFIC REACTOR TYPES, SEED AND BLANKET.

POWER REACTOR TECHNOLOGY 7, 197-200 /SPRING 1964/

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

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NAME/OWNER LSBR /LARGE SEED-BLANKET REACTOR/ WEST,
RICKOVER REACTOR

DESIGNER WESTINGHOUSE ELECTRIC CORPORATION

LOCATION PROPOSAL FOR PUMPING POWER, FEATHER RIVER PROJECT,
CONSIDERED BOTH COAST AND INLAND SITING.

PURPOSE PUMPING POWER FOR FEATHER RIVER PROJECT, PERHAPS
POWER AND WATER DESALINIZATION IF BUILT ON COAST.

TYPE PWR, SEED AND BLANKET, ADVANCED CONVERTER

POWER MWE(MWT) 525 1735

CRITICAL PLANNED

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM-235 AND THORIUM, OXIDE FUEL

FUEL GEOMETRY RODS

FUEL CHARGE FISSIONABLE 3300 KG., FERTILE 77000 KG.

SPECIFIC POWER 0.14 MWE/KG FISSIONABLE MATERIAL

BURNUP(REFUEL) 67 MWD/KG PER CYCLE CORE LIFE 10-12 YEARS

CONTROL MOVEMENT OF FUEL

COOLANT TEMP. INLET 271 C OUTLET 294 C

COOLANT PRESS. 136 ATM.

REMARKS CAL. DEPT. OF WATER RESOURCES PROPOSED THE LSBR
TO SUPPLY PART OF THE POWER REQUIREMENTS FOR THE
FEATHER RIVER PROJECT, BUT BECAUSE OF FUEL
DEVELOPMENT PROBLEMS THE STATION WILL NOT BE
CONTRACTED, SYSTEM DEVELOPMENT WILL BE REORIENTED
TO AN R+D PROGRAM DIRECTED TOWARD THERMAL BREEDER
TYPE DESIGN. LOS ANGELES DEPT. OF WATER AND POWER
MAY CONSIDER OFFER OF OFF-PEAK POWER FROM SEVERAL
UTILITIES FOR FEATHER RIVER, AND MAY STILL BE
CONSIDERING NUCLEAR POWER FROM SINGLE OR DUAL-
PURPOSE STATIONS.

REFERENCES DESIGN DATA FOR THE SEED-BLANKET REACTOR.

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NUCLEAR INDUSTRY 11. 5 /OCT. 1964/

REPORT ON LARGE POWER REACTOR /LPR/ PROGRAM.
BETTIS ATOMIC POWER LAB, WESTINGHOUSE
WAPD-LPR-181 /DEC. 1963/

PERFORMANCE POTENTIAL OF LARGE SEED-BLANKET
BREEDER REACTORS.
WAPD-LSBR-300 /FEB. 1965/

AEC NEWS RELEASE H-285 /DEC. 27, 1965/

SEE ALSO SHIPPINGPORT.

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

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NAME/OWNER	YANKEE ATOMIC ELECTRIC PLANT/YAEC		
DESIGNER	WESTINGHOUSE ELECTRIC CORPORATION		
OPERATOR	YANKEE ATOMIC ELECTRIC COMPANY		
LOCATION	ROWE, MASSACHUSETTS		
PURPOSE	POWER DEMONSTRATION		
TYPE	PWR		
POWER MWE(MWT)	110 134	392 /CORE 1/ 482 /CORE 2/	
CRITICAL	1960. FULL POWER JAN. 1961, CORE 2 NOV. 1963		
COOLANT	LIGHT WATER		
MODERATOR	LIGHT WATER		
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.294 IN. DIA./0.60 IN. LONG		
FUEL GEOMETRY	ROD, ACTIVE LENGTH 90 IN.		
FUEL CLADDING	SS TUBE 0.021 IN. WALL THICKNESS		
FUEL ENRICH.	3.4 PERCENT U-235 CORE 2 4.1 PERCENT		
FUEL ASSEMBLY	36-ROD SUBASSEMBLY, 6X6 9 SUBASSEMBLIES/FUEL ASSEMBLY, OPEN TYPE. 76 ASSEMBLIES/CORE		
FUEL CHARGE	20,840 KG. URANIUM		
SPECIFIC POWER	18.8 MWT/MTU		
BURNUP(REFUEL)	7830 MWD/MTU	SINGLE BATCH SEE REMARKS	
NEUTRON FLUX	THERMAL AVE. 2.0×10^{13}		
CONTROL	CRUCIFORM RODS, 24 RODS AND 8 SHIMS		
COOLANT TEMP.	INLET 499 F	OUTLET 603 F	
REACTOR VESSEL	WELDED CYLINDRICAL SHELL, SS-LINED CARBON STEEL		

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9 FT. 1 IN. ID./31 FT. 6 IN. HIGH, SURROUNDED BY
AN ANNULAR WATER-FILLED SHIELD TANK.

CONTAINMENT

SPHERICAL STEEL VESSEL SUPPORTED ON COLUMNS,
ENTIRELY ABOVE GROUND. VAPOR CONTAINER IS 125 FT.
DIA.

REMARKS

CORE 2 INCLUDED A NEW OUTER RING OF 36 ELEMENTS,
4.1 PER CENT ENRICHED. OUTPUT REACHED 136 MWE, AND
485 MWT. CHEMICAL SHIM OPERATION WAS BEGUN WITH
CORE 2 OPERATION.
EXPERIMENTS HAVE BEEN DONE ON OPERATION WITH SMALL
PARTS OF AMMONIA AND BORIC ACID IN THE COOLANT, TO
EXTEND CORE LIFE.
CORE 5 IS 1/2 CORE WITH 4.1 PER CENT ENRICHMENT
AND 1/2 CORE, LOADED IN 1965, WITH 4.9 PER CENT.
THE LESS ENRICHED FUEL WILL BE REPLACED IN SEPT.
1966 BY 4.9 PER CENT ENRICHED FUEL /CORE 6/, NEXT
REFUELING SCHEDULE IS MARCH 1968.

REFERENCES

PRELIMINARY HAZARDS SUMMARY REPORT. PART B.
LICENSE APPLICATION.
YANKEE ATOMIC ELECTRIC CO.
YAEC-60 /APRIL 1957/

THE START-UP EXPERIMENT PROGRAM FOR THE YANKEE
REACTOR.
JM GALLAGHER, JR., OTHERS
YAEC-184 /JUNE 1961/

DESIGN PRACTICE, YANKEE NUCLEAR POWER STATION.
POWER REACTOR TECHNOLOGY 4, 47-55 /JUNE 1961/

YANKEE NUCLEAR POWER STATION, TECHNICAL
INFORMATION AND FINAL HAZARDS SUMMARY REPORT.
PART B. LICENSE APPLICATION.
YANKEE ATOMIC ELECTRIC CO.
YAEC-167 /VOLS. 1 AND 2/ /APRIL 1960/

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PRESSURIZED LIGHT WATER REACTORS, DOMESTIC

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NAME/OWNER SAXTON EXPERIMENTAL POWER REACTOR/SNEC

DESIGNER WESTINGHOUSE ELECTRIC CORPORATION

OPERATOR SAXTON NUCLEAR EXPERIMENT CORP.

LOCATION SAXTON, PA

PURPOSE POWER EXPERIMENT.

TYPE PWR, CLOSED CYCLE HOOK-ON REACTOR

POWER MWE(MWT) 4-5 20

CRITICAL APRIL 1962. FULL POWER WITH CHEMICAL SHIM MARCH 1963.

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS 0.357 IN. DIA.
SEE REMARKS

FUEL GEOMETRY RODS ACT. LENGTH 36.6 IN.

FUEL CLADDING SS TUBES

FUEL ENRICH. 5.7 PER CENT U-235

FUEL ASSEMBLY 72-ROD ASSEMBLY, INCORPORATED IN FUEL-FOLLOWER OR
BOTTOM SECTION OF EACH CONTROL ROD ASSEMBLY.
21 ASSEMBLIES/CORE

FUEL CHARGE 1270 KG. URANIUM

SPECIFIC POWER 13.3 KW/FT.

BURNUP(REFUEL) 7300 MWD/T

CONTROL CRUCIFORM RODS, SILVER-INDIUM-CADMIUM, FUEL ROD
FOLLOWER.

COOLANT TEMP. INLET 520 F OUTLET 540 F

COOLANT PRESS. 2000 PSI

REACTOR VESSEL MULTILAYER CONSTRUCTION, 20 LAYERS OF 1 IN. STEEL
EACH LAYER WRAPPED TIGHTLY AND WELDED ON PRECEDING
LAYER.

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CONTAINMENT

VERTICAL CARBON STEEL CYLINDER, WELDED
HEMISPHERICAL HEAD, 50 FT. DIA./109 FT. 6 IN. HIGH
BOTTOM OF VESSEL IS EMBEDDED IN CONCRETE 50 FT.
BELOW GRADE. CONCRETE WALL WITH EXPANSION
MATERIAL BETWEEN CONCRETE AND STEEL SHELL.

REMARKS

CHEMICAL SHIM CONTROL WILL BE STUDIED IN THE
SAXTON REACTOR UNDER ACTUAL OPERATING CONDITIONS,
AS WELL AS DEVELOPMENT OF IMPROVED FUEL ELEMENTS
AND ASSEMBLIES. THE SAXTON CORE HAS PROVISIONS
FOR 5 REMOVABLE SUB-ASSEMBLIES OF 9 RODS EACH, AND
EXTENSIVE IN-CORE INSTRUMENTATION. PROVISION HAS
ALSO BEEN MADE FOR FUTURE INSTALLATION OF AN
IN-PILE SUPERHEAT TEST LOOP DESIGNED FOR ONCE-
THROUGH SUPERCRITICAL OPERATION AT 4000 PSI AND
1000 F STEAM TEMPERATURE.
AN EXTENDED PROGRAM ON PLUTONIUM OPERATION IS
BEING CONDUCTED. SAXTON HAS REACHED FULL POWER
ON A CORE CONTAINING PLUTONIUM FUEL, THE CENTRAL
NINE ASSEMBLIES OF THE CORE CONTAINING NATURAL
URANIUM DIOXIDE ENRICHED WITH PLUTONIUM DIOXIDE.

REFERENCES

THE SAXTON EXPERIMENTAL POWER REACTOR,
WE SHOUPP, OTHERS
POWER REACTOR EXPERIMENTS. VOL. 2, P. 229-51
INTERNATIONAL ATOMIC ENERGY AGENCY. VIENNA, 1962.

SAXTON EXPERIMENTAL POWER REACTOR,
EW POWELL, OTHERS
NUCLEAR ENG. 7, 393-97 /OCTOBER 1962/

OPERATING EXPERIENCE AT SAXTON.

WESTINGHOUSE ENG. MAY 1966 P. 93
NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

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NAME/OWNER	CONNECTICUT YANKEE STATION/CYAPC	
DESIGNER	WESTINGHOUSE ELECTRIC CORPORATION	
OPERATOR	CONNECTICUT YANKEE ATOMIC POWER CO.	
LOCATION	HADDAM NECK, CONNECTICUT	
PURPOSE	POWER. AEC 3RD-ROUND ASSISTANCE.	
TYPE	PWR, 4-LOOP SYSTEM	
POWER MWE(MWT)	463	1473
CRITICAL	CONSTRUCTION. TARGET 1967	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 0.375 IN. DIA./0.550 IN. LONG.	
FUEL GEOMETRY	RODS ACTIVE LENGTH 120 IN.	
FUEL CLADDING	SS TUBES 0.016 IN. WALL THICKNESS	
FUEL ENRICH.	ZONE ENRICHMENT 3.4, 3.8 AND 4.2 PER CENT U-235	
FUEL ASSEMBLY	225 AND 209-ROD ASSEMBLIES, GRID-CLIP TYPE. 157 ASSEMBLIES/CORE. VERTICAL LOADING. IN 1/2 OF THE ASSEMBLIES, 16 FUEL RODS ARE REPLACED BY CONTROL-ROD GUIDE THIMBLES.	
FUEL CHARGE	75,500 KG. URANIUM DIOXIDE	
BURNUP(REFUEL)	20,000 MWD/MTU	12-14 MONTHS
NEUTRON FLUX	THERMAL AVE. 2.3×10^{13} FAST AVE. 1.6×10^{14}	
CONTROL	ROD-CLUSTER CONTROL	
COOLANT TEMP.	INLET 546 F	OUTLET 587 F
COOLANT PRESS.	2065 PSIG	
REACTOR VESSEL	STEEL CYLINDER, SS LINED. 154 IN. ID/41 FT. HIGH.	
CONTAINMENT	REINFORCED CONCRETE VESSEL LINED WITH WELDED	

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HD31

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STEEL PLATE.

REMARKS

COLLAPED SS CLADDING MAY BE SPECIFIED FOR THE FUEL
WITH ZIRCALOY POSSIBLE FOR LATER CORES. FUEL
OF EACH ENRICHMENT IS SYMMETRICALLY ARRANGED TO
REDUCE FUEL SHUFFLING.

REFERENCES

CONNECTICUT YANKEE ATOMIC POWER COMPANY NUCLEAR
POWER PLANT-UNIT NUMBER ONE, HADDAM, CONNECTICUT.
PRELIMINARY HAZARDS SUMMARY REPORT.
CONNECTICUT YANKEE ATOMIC POWER CO.
NYO-3250-1 /DEC. 1963/

TITLE 1 AND TITLE 2, DESIGN AND ENGINEERING.
ANNUAL REPORT. MARCH 1963-JUNE 1964.
CONNECTICUT YANKEE ATOMIC POWER CO.
TID-21129 /AUG. 1964/

CONNECTICUT YANKEE
JN KILPATRICK, FS BEAL /WESTINGHOUSE/
NUCLEAR ENG. 10. 216-20 /JUNE 1965/

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HD32

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NAME/OWNER MALIBU PLANT / LADWP

DESIGNER WESTINGHOUSE ELECTRIC CORPORATION

OPERATOR LOS ANGELES DEPT. WATER AND POWER

LOCATION MALIBU BEACH, CALIF. /CORRAL CANYON/

PURPOSE POWER,

TYPE PWR, 4-LOOP SYSTEM

POWER MWE(MWT) 490 1473

CRITICAL CONDITIONAL CONSTRUCTION PERMIT GRANTED JULY 1966

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL GEOMETRY RODS

FUEL CLADDING REGIONS 1,2 AND 3 USE SS, REGION 4 /AND FUTURE/
USES ZIRCALOY

FUEL ENRICH. REGIONAL 3.8 PER CENT U-235

CONTROL ROD CLUSTER, CHEMICAL SHIM

CONTAINMENT DOUBLE-BARRIER CONTAINMENT, LAYER OF POROUS
CONCRETE BETWEEN INNER AND OUTER SHELLS OF STEEL
AND REINFORCED CONCRETE,

REMARKS AEC HAS ACCEPTED PROPOSAL FROM LADWP FOR R&D AND
DESIGN ASSISTANCE UNDER MODIFIED THIRD-ROUND RULES
STATION DESIGN IS SIMILAR TO CONNECTICUT YANKEE.

REFERENCES TECHNICAL INFORMATION IN SUPPORT OF APPLICATION
FOR CONSTRUCTION PERMIT AND LICENSE. MALIBU
NUCLEAR PLANT UNIT NO. 1,
DEPT. WATER AND POWER, CALIF., STONE + WEBSTER,
NP-14290 /PT.8/ /NOV. 1963/

NUCLEONICS WEEK JULY 21, 1966
NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS, DOMESTIC

HD33

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NAME/OWNER SAN ONOFRE NUCLEAR PLANT/S.CAL. ED., S. DIEGO G+E
 CAMP PENDLETON

DESIGNER WESTINGHOUSE ELECTRIC CORPORATION

OPERATOR SOUTHERN CALIFORNIA EDISON COMPANY

LOCATION SAN CLENETE, CALIF.

PURPOSE POWER

TYPE PWR, 3-LOOP SYSTEM, CLOSED CYCLE.

POWER MWE(MWT) 450 1150

CRITICAL ON-LINE MAY 1967

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS 0.380 IN. DIA./0.60 IN.

FUEL GEOMETRY ROD, 0.422 IN. OD/120 IN. LONG
 ACTIVE LENGTH 10 FT.

FUEL CLADDING SS 0.0165 IN. THICK

FUEL ENRICH. 3.5 PER CENT U-235, ZONE ENRICHMENT

FUEL ASSEMBLY 180-ROD BUNDLE, 14X14
 RCC ELEMENTS /ROD CLUSTER CONTROL/
 157 ASSEMBLIES/CORE
 3-REGION CORE ARRANGEMENT

FUEL CHARGE 150,000 POUNDS URANIUM DIOXIDE
 58,000 KG. URANIUM

BURNUP(REFUEL) 13,500 MWD FUEL SHUFFLING
 14-MONTH INTERVALS

CONTROL ROD CLUSTER CONTROL /RCC/, A SERIES OF SMALL
 INDIVIDUAL CONTROL ELEMENTS ARRANGED IN A CLUSTER,
 CHEMICAL SHIM

COOLANT TEMP. INLET 553 F OUTLET 597 F

COOLANT PRESS. 2065 PSIA

REACTOR VESSEL SS-LINED CARBON STEEL VESSEL 41 FT. LONG /12 FT.

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD33

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ID.

CONTAINMENT

STEEL SPHERE 100 FT. DIA., 40 FT. BELOW GRADE,
AIR-TIGHT, WITH CONCRETE STRUCTURE INSIDE SPHERE
FOR SUPPORT AND SHIELDING.

REMARKS

BASIC THREE-LOOP REACTOR, VARYING PLANT SIZE IS
ACHIEVED BY VARYING VESSEL AND CORE SIZE AND THE
NUMBER OF LOOPS. LOOP COMPONENTS REMAIN THE SAME.
SAN DIEGO GAS + ELECTRIC WILL CONTRIBUTE TO PLANT
COSTS IN RETURN FOR SHARE OF POWER PRODUCED.
CLADDING FOR SUBSEQUENT CORES WILL PROBABLY
BE ZIRCALOY.

REFERENCES

SOUTHERN CALIFORNIA EDISON REACTOR CHARACTERISTICS
NUCLEONICS 18, 18 /JUNE 1960/

PRELIMINARY HAZARDS SUMMARY REPORT ON
SOUTHERN CALIFORNIA EDISON COMPANY NUCLEAR
STATION AT CAMP PENDLETON, CALIFORNIA,
UNIT NO. 1. PART B,
SOUTHERN CALIFORNIA EDISON CO.
NP-12513 /JAN, 1963/

DESIGN FEATURES OF THE SAN ONOFRE NUCLEAR STATION
HJ VON HOLLEN, CF CURREY
WESTINGHOUSE ENG. 25, 142-47 /SEPT. 1965/

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1,
FINAL ENGINEERING AND SAFETY ANALYSIS
VOL. 1, 2, 3 /S.CALIF. ED., SAN DIEGO/
NYO-3270-2 /ND/

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD34

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NAME/OWNER SCOTT-R /SUPERCRIT ONCE THROUGH TUBE REACTOR/ WEST
 DESIGNER WESTINGHOUSE ELECTRIC CORPORATION
 PURPOSE POWER
 TYPE PWR, PRESSURE TUBE
 POWER MWE(MWT) 1000 2297
 CRITICAL DESIGN DEVELOPMENT.
 COOLANT LIGHT WATER
 MODERATOR GRAPHITE, GRAPHITE REFLECTOR
 FUEL MATERIAL URANIUM DIOXIDE
 FUEL GEOMETRY RODS, CONCENTRIC RINGS
 FUEL CLADDING SS 0.012 IN. THICK, TUBES.
 FUEL ENRICH. 3.03 PER CENT U-235
 FUEL ASSEMBLY ASSEMBLY CONSISTS OF 1 ROD AND 4 CONCENTRIC RINGS.
 540 ASSEMBLIES IN 540 PRESSURE TUBES.
 FUEL CHARGE 121,900 KG URANIUM
 SPECIFIC POWER 18.9 KWT/KG URANIUM
 BURNUP(REFUEL) 16,500 MWD/MTU
 CONTROL BORON CARBIDE RODS
 COOLANT TEMP. INLET 506 F
 COOLANT PRESS. 3750 PSIA
 REACTOR VESSEL CARBON STEEL 42 FT. HIGH BY 35.5 FT. ID.
 PRESSURE TUBES ARE ZIRCONIUM ALLOY, INNER LINER OF
 ZIRCONIUM-TANTALUM-TUNGSTEN.
 REMARKS PRELIMINARY DESIGN OF THE 50 MWT SUPERHEAT POWER
 EXP. IS COMPLETED. TWO POWER CYCLES STUDIED WERE
 THE IN-CORE REHEAT, IN WHICH 600 PSIA STEAM
 EXHAUSTED FROM THE HIGH PRESSURE TURBINE IS
 REHEATED IN THE CORE TO 1000 F. AND CONDENSING
 STEAM REHEAT WHERE 182 PSIA STEAM IS REHEATED IN A
 HEAT EXCHANGER BY BLEED STEAM FROM THE HIGH

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PRESSURIZED LIGHT WATER REACTORS, DOMESTIC

HD34

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PRESSURE TURBINE. IN THE REFERENCE DESIGN, THE COOLANT FLOW MAKES 4 CONSECUTIVE PASSES, OUTSIDE TO CENTER OF THE FUEL ASSEMBLY. SCOTT-R WAS SELECTED FOR FURTHER DEVELOPMENT BY AEC.

REFERENCES

THE ROLE OF A SUPERHEAT POWER EXPERIMENT IN THE DEVELOPMENT OF SUPERCRITICAL STEAM NUCLEAR-FIRED POWER PLANTS.

JH WRIGHT, OTHERS

ASME PREPRINT 62-WA-345 /DECEMBER 1962/

THE SCOTT-R DEVELOPMENT PROGRAM,

JH WRIGHT

WESTINGHOUSE ENG. 23, 50-53 /MARCH 1963/

SUPERCRITICAL WATER REACTORS.

POWER REACTOR TECHNOLOGY 6/3/, 73-8 /JUNE 1963/

1000-MWE SCOTT-R CONCEPTUAL DESIGN.

SN TOWER

TID-7674 /P. 65-6/

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD35

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NAME/OWNER	RAVENSWOOD NUCLEAR UNIT/CONSOLIDATED EDISON	
DESIGNER	WESTINGHOUSE ELECTRIC CORPORATION	
PURPOSE	POWER	
TYPE	PWR, CLOSED CYCLE, 5-LOOP SYSTEM. OIL-FIRED SUPERHEAT	
POWER MWE(MWT)	1000	2850
CRITICAL	PROPOSAL HAS BEEN WITHDRAWN	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS, 0.375 IN. DIA./0.736 IN. LONG.	
FUEL GEOMETRY	RODS, 120 IN. ACTIVE LENGTH	
FUEL CLADDING	SS TUBE, 0.013 IN. WALL THICKNESS	
FUEL ENRICH.	ZONE ENRICHMENT 3.2, 3.6 AND 4 PER CENT U-235	
FUEL ASSEMBLY	280-ROD BUNDLES, 17X17 /9RODS OMITTED FOR CONTROL ROD PASSAGE/ 156 ASSEMBLIES IN CORE, EACH ENRICHMENT ZONE HAVING 52 ASSEMBLIES.	
FUEL CHARGE	103,000 KG, URANIUM DIOXIDE	
BURNUP(REFUEL)	12000 MWD/MTU	
CONTROL	CHEMICAL SHIM, CONTROL RODS	
COOLANT TEMP.	INLET 543 F	OUTLET 588 F
COOLANT PRESS.	2035 PSIG	
REACTOR VESSEL	STEEL, 46 FT. 6 1/2 IN. LONG	
CONTAINMENT	MULTI-WALL CONTAINMENT. TWO CARBON STEEL SHELLS WITH PERVIOUS CONCRETE BETWEEN THEM, AND NORMAL HIGH-DENSITY REINFORCED CONCRETE OUTER SHELL.	
REMARKS	PROPOSAL FOR THE NUCLEAR PLANT WAS WITHDRAWN BY CONSOLIDATED EDISON IN JANUARY 1964. SITE WAS TO HAVE BEEN WITHIN NEW YORK CITY.	

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HD35

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REFERENCES

PRELIMINARY HAZARDS SUMMARY REPORT, DOCKET 50-204
 RAVENSWOOD NUCLEAR GENERATING UNIT A,
 CONSOLIDATED EDISON CO. OF N.Y., INC. 1962,
 NP-12466 /VOL. 1,2, AND 3/

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD36

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NAME/OWNER POINT BEACH NUCLEAR STATION/WMPCO
DESIGNER WESTINGHOUSE ELECTRIC CORP.
OPERATOR WISCONSIN MICHIGAN POWER CO. /WMPCO/
LOCATION TWO CREEKS, MANITOWOC COUNTY, WISCONSIN
PURPOSE POWER
TYPE PWR, 2-LOOP SYSTEM
POWER MWE(MWT) 454
CRITICAL CONTRACT AWARD JAN, 1966, TARGET 1970
COOLANT LIGHT WATER
MODERATOR LIGHT WATER
REFERENCES NUCLEONICS WEEK FEB. 3, 1966 P. 3
 NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD37

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NAME/OWNER HARTSVILLE NUCLEAR STATION/CAROLINA LIGHT-POWER

DESIGNER WESTINGHOUSE ELECTRIC CORP.

LOCATION HARTSVILLE, S. CAROLINA

PURPOSE POWER

TYPE PWR, 3-LOOP SYSTEM

POWER MWE(MWT) 700

CRITICAL COMMERCIAL OPERATION TARGET 1970

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

REMARKS CONTRACT AWARD JAN, 1966

REFERENCES NUCLEONICS WEEK FEB, 3, 1966 P, 3
NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD38

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NAME/OWNER TURKEY POINT 3 AND 4/FLORIDA POWER/LIGHT
 DESIGNER WESTINGHOUSE ELECTRIC CORP.
 LOCATION TURKEY POINT, FLORIDA
 TYPE PWR, 3-LOOP SYSTEM
 POWER MWE(MWT) 652 2300
 ULTIMATE 760 GROSS
 CRITICAL UNIT 3 TARGET 1970
 UNIT 4 TARGET 1971
 COOLANT LIGHT WATER
 MODERATOR LIGHT WATER
 FUEL MATERIAL URANIUM DIOXIDE PELLETS 0.3699 IN. DIA/0.600 IN.
 FUEL GEOMETRY ROD 0.422 IN. OD. ACT. LENGTH 144 IN.
 FUEL CLADDING ZIRCALOY 0.0243 IN. THICK
 FUEL ENRICH. ZONED, 2.73, 2.43, 2.28 PER CENT U-235
 FUEL ASSEMBLY 204 RODS/ASSEMBLY, SPRING-CLIP GRID,
 157 ASSEMBLIES
 FUEL ASSEMBLIES CONTAIN GUIDE THIMBLES
 FOR THE RCC ASSEMBLIES
 FUEL CHARGE 179,000 POUNDS URANIUM DIOXIDE
 BURNUP(REFUEL) 21,800 MWD/MTU
 CONTROL ROD-CLUSTER CONTROL ASSEMBLIES
 ABSORBER INDIUM-CADMIUM-SILVER IN SS TUBES
 CHEMICAL SHIM
 COOLANT TEMP. INLET 546.5 F OUTLET 600 F
 COOLANT PRESS. 2235 PSIG
 REACTOR VESSEL STEEL VESSEL 155.5 IN. ID./240 IN. OD. ACROSS
 NOZZLES, HEIGHT 41 FT.
 SS CLADDING 5/32 IN. THICK
 CONTAINMENT STEEL-LINED PRESTRESSED CONCRETE CYLINDER, FLAT
 BOTTOM, SHALLOW DOMED ROOF
 REMARKS BOTH NUCLEAR UNITS WILL BE IDENTICAL EXCEPT FOR

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CHANGES RESULTING FROM TECHNICAL ADVANCES.

REFERENCES

TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND 4.
PRELIMINARY SAFETY ANALYSIS REPORT
FLORIDA LIGHT POWER CO.
NP-16146 /VOL.2, PLANT DESIGN DESCRIPTION AND
SAFETY ANALYSIS/.

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD39

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NAME/OWNER OCONEE STATION 1 AND 2/DUKE POWER
 OCONEE 1 AND 2

DESIGNER BABCOCK AND WILCOX

LOCATION KEOWEE DAM, S. CAROLINA

PURPOSE POWER, 2-REACTOR STATION

TYPE PWR

POWER MWE(MWT) 822

CRITICAL CONTRACT AWARD JULY 1966, FUEL LOADING DEC. 1970
 TARGET NO. 1, 1971
 TARGET NO. 2, 1972

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL CLADDING ZIRCALOY TUBES

FUEL ENRICH. ZONE ENRICHMENT PATTERN

BURNUP(REFUEL) FUEL SHUFFLING, ANNUAL.

CONTROL CLUSTER-TYPE RODS, CHEMICAL SHIM

REFERENCES NUCLEONICS WEEK JULY 7, 1966 P. 1-2
 NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD40

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NAME/OWNER DELAWARE VALLEY-1/DELAWARE VALLEY UTILITIES

DESIGNER WESTINGHOUSE ELECTRIC CORP.

LOCATION NEAR TRENTON, N.J.

PURPOSE POWER

TYPE PWR, 4-LOOP SYSTEM

POWER MWE(MWT) 993

CRITICAL TARGET 1971

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL GEOMETRY RODS

FUEL CLADDING ZIRCALOY

FUEL ENRICH. REGIONAL

FUEL ASSEMBLY BUNDLES

CONTROL ROD-CLUSTER CONTROL

REMARKS CONTRACT AWARD AUGUST 1966,
FIRST OF UNITS
UNITS 2 AND 3 WILL BE BUILT BY GE. SEE BD36

REFERENCES NUCLEONICS WEEK AUG. 18, 1966 P. 3
NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS, DOMESTIC

HD41

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NAME/OWNER VEP CO STATION/VIRGINIA ELECTRIC POWER CO.
 SURRY REACTOR

DESIGNER WESTINGHOUSE ELECTRIC CORP,

OPERATOR VIRGINIA ELECTRIC POWER CO,

LOCATION HOG ISLAND /ON JAMES RIVER/ VIRGINIA

PURPOSE POWER

TYPE PWR, 2-REACTOR STATION

POWER MWE(MWT) 800 /PER REACTOR/

CRITICAL NO.1 REACTOR 1971
 NO.2 REACTOR 1972

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

REFERENCES NUCLEONICS WEEK OCT, 6, 1966 P, 1
 NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS, DOMESTIC

HD42

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NAME/OWNER	OMAHA PUBLIC POWER DISTRICT STATION/OMAHA PUBLIC
DESIGNER	COMBUSTION ENGINEERING
OPERATOR	OMAHA PUBLIC POWER DISTRICT
LOCATION	NEAR OMAHA, NEBRASKA
PURPOSE	POWER
TYPE	PWR
POWER MWE(MWT)	450
CRITICAL	TARGET 1971
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE
FUEL GEOMETRY	RODS
FUEL CLADDING	ZIRCALLOY-4
FUEL ASSEMBLY	144-ROD ASSEMBLY
CONTROL	RODS, CHEMICAL SHIM
REMARKS	CONTRACT AWARD OCTOBER 1966 PLANS ARE FOR TWO UNITS AT SITE
REFERENCES	NUCLEONICS WEEK OCT, 31, 1966 P. 1 NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS, DOMESTIC

HD43

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NAME/OWNER	METROPOLITAN EDISON REACTOR/METROPOLITAN EDISON
DESIGNER	BABCOCK + WILCOX
OPERATOR	METROPOLITAN EDISON
LOCATION	SOUTHEASTERN PENNSYLVANIA
PURPOSE	POWER
TYPE	PWR, TWIN-REACTOR STATION
POWER MWE(MWT)	840
CRITICAL	TARGET 1971
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE
FUEL GEOMETRY	ZIRCALOY TUBES
CONTROL	CLUSTER-TYPE RODS CHEMICAL SHIM
REMARKS	CONTRACT AWARD NOVEMBER 1966
REFERENCES	NUCLEONICS WEEK NOV. 24, 1966 P. 1-2 NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS. DOMESTIC

HD44

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NAME/OWNER	DIABLO CANYON/PACIFIC G AND E
DESIGNER	WESTINGHOUSE ELECTRIC COPR.
OPERATOR	PACIFIC GAS AND ELECTRIC CO.
LOCATION	DIABLO CANYON, NEAR SAN LUIS OBISPO, CALIF.
PURPOSE	POWER
TYPE	PWR
POWER MWE(MWT)	1060
CRITICAL	TARGET 1971
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
REMARKS	CONTRACT AWARD NOVEMBER 1966
REFERENCES	NUCLEONICS WEEK NOV. 24, 1966 P. 2 NEWS RELEASE

PRESSURIZED LIGHT WATER REACTORS

FOREIGN

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF01

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NAME/OWNER BR-3 /BELGIAN REACTOR-3/CEN, BELGIUM
DESIGNER WESTINGHOUSE ELECTRIC CORP.
OPERATOR CEN, BELGIUM
LOCATION MOL, BELGIUM
PURPOSE POWER EXPERIMENT, TEST AND TRAINING
TYPE PWR
POWER MWE(MWT) 10 40
CRITICAL 1961. FULL POWER OCT. 1962.
COOLANT LIGHT WATER
MODERATOR LIGHT WATER
FUEL MATERIAL URANIUM DIOXIDE PELLETS, 0.300 IN. DIA./0.600 IN. LONG
FUEL GEOMETRY ROD, ACTIVE LENGTH 56 IN.
FUEL CLADDING SS TUBES, 0.343 IN. OD. AND 21 MILS WALL THICKNESS
FUEL ENRICH. ZONAL, INNER 3.7 PERCENT, PERIPHERAL 4.4
FUEL ASSEMBLY 110-111 ROD ASSEMBLY, BRAZED.
32 ASSEMBLIES IN CORE, 16 IN EACH ENRICHMENT ZONE.
FUEL CHARGE 5000 LBS. FUEL
BURNUP(REFUEL) 7000 FULL-POWER HOURS LIFE./BATCH, FUEL SHUFFLING/
NEUTRON FLUX THERMAL AVE. 2.4×10^{13}
FAST AVE. 1.4×10^{14}
CONTROL RODS, SILVER-INDIUM-CADMIUM
COOLANT TEMP. INLET 491 F OUTLET 515 F
COOLANT PRESS. 2000 PSIA
REACTOR VESSEL CARBON STEEL VERTICAL CYLINDER, 58 IN. ID. AND 18 FT. HIGH, SS INNER CLADDING.
CONTAINMENT STEEL VESSEL 54 FT. DIA. BY 107 FT. HIGH, INNER

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PRESSURIZED LIGHT WATER REACTORS, FOREIGN

HF01

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CONCRETE SHIELDING, 1/4 BELOW GROUND LEVEL.

REMARKS

SHUT-DOWN IN NOVEMBER 1963 FOR FUEL REPLACEMENT,
24 OF THE FIRST-CORE ELEMENTS MOVED FROM PERIPHERY
TO CENTER AND 7 NEW ELEMENTS LOADED. LOADING
INCLUDED AN EXPERIMENTAL ELEMENT CONTAINING
URANIUM-PLUTONIUM OXIDE. THE BR-3 WILL BE
OPERATED AS AN EXPERIMENTAL SPECTRAL-SHIFT
FACILITY IN CONNECTION WITH THE VULCAIN PROGRAM,
WITH PROGRAM COMPLETION IN 1967. TWELVE RODS
CONTAINING PLUTONIUM-ENRICHED URANIUM WERE
CHARGED TO THE CORE IN APRIL, 1964.

REFERENCES

BR-3. GENERAL DESCRIPTION, DESIGN PHILOSOPHY AND
PLANT CONSTRUCTION, CORE DESIGN AND TESTING,
L MERGAN, OTHERS
NUCLEAR ENG. 5. 337-52 /AUGUST 1960/

THE BR-3 REACTOR.
WF DAVIS
WESTINGHOUSE ENG. 20. 162-5 /NOVEMBER 1960/

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PRESSURIZED LIGHT WATER REACTORS, FOREIGN

HF03

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NAME/OWNER	FRANCO-BELGIAN ARDENNES NUCLEAR STATION/SENA, ITALY	
DESIGNER	WESTINGHOUSE ELECTRIC CORP.	
OPERATOR	SENA, ITALY	
LOCATION	CHOOZ, FRANCE /NEAR GIVET/	
PURPOSE	POWER, US-EURATOM PROJECT.	
TYPE	PWR	
POWER MWE(MWT)	288	825
	SEE REMARKS	
CRITICAL	CONSTRUCTION TARGET 1967	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	RODS	
FUEL CLADDING	SS TUBES 15.1 MILS THICK WALLS	
FUEL ENRICH.	3.1 PER CENT U-235	
FUEL ASSEMBLY	208-ROD ASSEMBLY CENTRAL POSITION VACANT, EGG-CRATE ASSEMBLY WITH SPRING CLIPS, 120 ASSEMBLIES/CORE	
FUEL CHARGE	45000 KG URANIUM DIOXIDE	
BURNUP(REFUEL)	14700 MWD/T	BATCH, FUEL SHUFFLING,
NEUTRON FLUX	THERMAL 2.3 E+13	
CONTROL	SS TUBES CONTAINING SILVER-INDIUM-CADMIUM ALLOY CHEMICAL SHIM	
COOLANT TEMP.	INLET 267 C	OUTLET 300 C
COOLANT PRESS.	2148 PSIA	
REACTOR VESSEL	STEEL VERTICAL CYLINDER 39.4 FT. HIGH BY 10.5 FT. ID. SS INNER CLADDING	

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF03

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CONTAINMENT UNDERGROUND CONSTRUCTION /CAVERN/

REMARKS CONSTRUCTION HAS BEEN EXTENDED ABOUT 6 MONTH TO
ALLOW AN INCREASE IN DESIGNED POWER TO 288 MWE,
CRITICALITY TARGET IS JULY 1966. WESTINGHOUSE
WILL SUPPLY THE FIRST CORE, THE SECOND WILL BE
FABRICATED BY SOCIETE BELGE METALLURGIE ET
MECANIQUE NUCLEAIRE.

REFERENCES THE SENA UNDERGROUND PWR,
NUCLEAR POWER 7, 79 /FEBRUARY 1962/

THE ARDENNES NUCLEAR STATION,
PIERRE-A GRAU, PIERRE-A ERKES
INDUSTRIES ATOMIQUES NO. 1/2, 1964, P. 55-64

ARDENNES NUCLEAR CENTRAL STATION. SPECIAL FEATURES
AND IMPROVEMENTS IN COMPARISON WITH SIMILAR
EXISTANT PLANTS,
P ERKES
3RD. U.N. INTL. CONF. PEACEFUL USES OF ATOMIC
ENERGY, GENEVA, 1964.
A/CONF. 28/P/514

SENA--BELGIAN-FRENCH ATOMIC POWER STATION
ATOMWIRTSCHAFT 11, 444-46 /AUG-SEPT. 1966/

JANUARY 1967

BNWL-326

PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF04

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NAME/OWNER SSR-4 / FIAT, ANSALDO, CNEN-ITALY

DESIGNER FIAT, ITALY

PURPOSE NUCLEAR TANKER PROPULSION

TYPE PWR, FORCED CIRCULATION, COMPACT DESIGN.

POWER MWE(MWT) 23000 SHP 74

CRITICAL: DESIGN AND DEVELOPMENT.

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

CONTROL CHEMICAL SHIM

CONTAINMENT PRESSURE-SUPPRESSION.

REMARKS THE ITALIAN GOVERNMENT IS NEARING A DECISION TO BUILD A NUCLEAR POWERED NAVAL SUPPORT VESSEL, USING A COMPACT PWR, RATED AT 60 MWT, OF EXCLUSIVELY ITALIAN DESIGN, FUEL WOULD BE 4 PER CENT ENRICHED URANIUM. IN A SEPARATE PROJECT FIAT, ANSALDO, AND CNEN ARE COMPLETING DETAILS FOR BUILDING A FULL-SCALE LAND-BASED PROTOTYPE OF A COMPACT PWR.

REFERENCES NUCLEAR INDUSTRY FEB. 1966 P. 24-5
NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF05

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NAME/OWNER	ENRICO FERMI NUCLEAR STATION/SELNI, ITALY	
DESIGNER	WESTINGHOUSE ELECTRIC CORP.	
OPERATOR	SOCIETA ELETTRONUCLEARE ITALIANA /SELNI/	
LOCATION	TRINO VERCELLESE /ON PO RIVER/, ITALY	
PURPOSE	POWER	
TYPE	PWR, CLOSED CYCLE	
POWER MWE(MWT)	290	825 WITH CHEMICAL SHIM
CRITICAL	JUNE 1964. POWER OPERATION SEPT. 1964	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS, 0.35 IN. DIA. SINTERED	
FUEL GEOMETRY	ROD, ACTIVE LENGTH 103.2 IN.	
FUEL CLADDING	SS TUBE, 15 MILS WALL THICKNESS	
FUEL ENRICH.	2.7 PER CENT U-235 /3-REGION ENRICHMENT/	
FUEL ASSEMBLY	208-ROD ASSEMBLY, 15X15. OMISSIONS FOR CONTROL RODS SPRING-CLIP ASSEMBLY, BOX-TYPE 120 FUEL ASSEMBLIES	
BURNUP(REFUEL)	FUEL SHUFFLING, BATCH	
CONTROL	RODS, SILVER-INDIUM-CADMIUM, FUEL-ROD FOLLOWERS, CHEMICAL SHIM.	
COOLANT TEMP.	539.5 F	
COOLANT PRESS.	2200 PSIA	
REACTOR VESSEL	STEEL VESSEL 144 IN. OD. BY 465 IN. HIGH, 8 IN. THICK WALLS.	
CONTAINMENT	CONTAINMENT SHELL. ADJACENT ANNULUS PROVIDED BY SPLITTING THE SECONDARY BIOLOGICAL SHIELDING INTO TWO PORTIONS. THE ANNULUS CAN BE KEPT AT A PRESSURE SLIGHTLY BELOW ATMOSPHERIC.	

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HF05

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REMARKS

SELNI WILL PIONEER CHEMICAL SHIM CONTROL AND
3-REGION ENRICHMENT CORES. EVENTUAL OUTPUT WILL
BE 290 MWE BY THE INSTALLATION OF A FURTHER
TURBOGENERATOR.

REFERENCES

EUROPEAN POWER REACTORS. ITALY,
MECH. ENG. 81, 63 /NOVEMBER 1959/

ATOMIC ENERGY IN ITALY,
NUCLEAR POWER 7, 51-78 /FEBRUARY 1962/

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PRESSURIZED LIGHT WATER REACTORS, FOREIGN

HF06

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NAME/OWNER OCEANOGRAPHIC RESEARCH VESSEL/JAPSD-JAPAN

DESIGNER MITSUBISHI ATOMIC POWER INDUSTRY CO.-JAPAN
/MAPI/

PURPOSE SHIP PROPULSION

TYPE PWR

POWER MWE(MWT) 35

CRITICAL CONSTRUCTION 1967
TARGET 1970-1972

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL CLADDING SS

FUEL ENRICH. TWO-REGION CORE, LOW ENRICHMENT,

BURNUP(REFUEL) 5860 MWD/T

REMARKS JAPSD HAS WORKED OUT A SET OF BASIC CONDITIONS FOR
PROPOSED CONSTRUCTION OF A 6,000 TON OCEANIC
OBSERVATION VESSEL POWERED BY NUCLEAR ENERGY.
SPECIFICATIONS WERE COMPLETED AND BIDS REQUESTED
IN FEBRUARY 1965.REFERENCES NUCLEONICS WEEK JULY 21, 1966
NEWS RELEASE

JANUARY 1967

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PRESSURIZED LIGHT WATER REACTORS, FOREIGN

HF07

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NAME/OWNER	NERO PROJECT/RCN, THE NETHERLANDS-EURATOM	
DESIGNER	RCN, THE NETHERLANDS	
LOCATION	CRITICAL EXPERIMENT KRITO AT PETTEN RESEARCH ESTAB., THE NETHERLANDS	
PURPOSE	SHIP PROPULSION	
TYPE	PWR, NATURAL CIRCULATION	
POWER MWE(MWT)	20,000 SHP	61
CRITICAL	DEVELOPMENT	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 10,03 MM. DIA. BORON CARBIDE BURNABLE POISON	
FUEL GEOMETRY	RODS	
FUEL CLADDING	ZIRCALOY TUBE 1,7 MM. THICK.	
FUEL ENRICH.	TWO-ZONE, 4,4 AND 4,8 PER CENT U-235	
FUEL ASSEMBLY	30 FULL-SIZED ELEMENTS 12 SUB-SIZED ELEMENTS 4218 RODS/CORE	
FUEL CHARGE	4600 KG, URANIUM DIOXIDE	
BURNUP(REFUEL)	16,600 MWD/MT URANIUM DIOXIDE	4-YEAR PERIODS
CONTROL	RODS, CADMIUM-SILVER-INDIUM, AND BORON CARBIDE POISON IN FUEL	
COOLANT TEMP.	INLET 270 C	OUTLET 299 C
COOLANT PRESS.	140 KG/SQ. CM.	
REMARKS	KRITO, CRITICAL IN MARCH 1963, IS FUELED WITH 3.1 AND 3,8 PERCENT URANIUM DIOXIDE PELLETS IN ALUMINUM TUBES, INCORPORATING BORON CARBIDE AS POISON MATERIAL. DESIGN OF NERO IS FOR A COMPACT INSTALLATION WITH A LONG CORE LIFE. INCREASED WATER CIRCULATION THROUGH THE CORE IS OBTAINED BY	

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF07

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HYDRAULIC EJECTORS INSIDE THE REACTOR VESSEL AND
A COMBINED UNIT FOR HEAT EXCHANGER, SUPERHEATER,
AND PUMP FOR THE EXTERNAL CIRCUIT.

REFERENCES

THE CRITICAL FACILITY KRITO
JG ACKERS, OTHERS
INTL. ATOMIC ENERGY AGENCY,
SYMP. OF EXPONENTIAL AND CRITICAL EXPERIMENTS
WITH CALCULATIONS, AMSTERDAM, SEPT, 1963.
EUR-498E /1964/

THE NERO REACTOR FOR SHIP PROPULSION.
M BOGAARDT, M MUYSKEN
3RD U.N. INTL. CONF. PEACEFUL USES OF ATOMIC
ENERGY, GENEVA, 1964.
A/CONF. 28/P/588

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF08

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NAME/OWNER	PUERTO RICO PWR/PRWRA, PUERTO RICO
DESIGNER	WESTINGHOUSE ELECTRIC CORP.
OPERATOR	PUERTO RICO WATER RESOURCES AUTHORITY
LOCATION	PALO SECO OR TORTUGUERO, PUERTO RICO
PURPOSE	POWER
TYPE	PWR
POWER MWE(MWT)	200
CRITICAL	HAS BEEN CANCELED
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
REMARKS	PROPOSED, CONVENTIONAL PLANT WILL BE BUILT.
REFERENCES	NEWS RELEASE.

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF09

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NAME/OWNER ZORITA NUCLEAR STATION/UEM, SPAIN

DESIGNER WESTINGHOUSE ELECTRIC CORP,

OPERATOR UNION ELECTRICA MADRILENA, SPAIN

LOCATION ZORITA DE LOS CANES, TAJO RIVER, SPAIN
 NEAR MADRID

PURPOSE POWER

TYPE PWR, SINGLE LOOP SYSTEM.

POWER MWE(MWT) 153

CRITICAL CONSTRUCTION. TARGET 1968

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL GEOMETRY RODS

FUEL CLADDING ZIRCALOY

FUEL ENRICH. 3.15 PER CENT U-235, ZONE ENRICHMENT

FUEL CHARGE 17 TONS URANIUM

BURNUP(REFUEL) 24,000 MWD/T

NEUTRON FLUX THERMAL AVE. 1.6×10^{13}

CONTROL CHEMICAL SHIM

REMARKS WESTINGHOUSE RECEIVED CONTRACT FOR CONSTRUCTION OF
 THE COMMERCIAL NUCLEAR POWER PLANT, AND WILL BE
 RESPONSIBLE FOR PLANT DESIGN, FURNISH AND INSTALL
 ALL EQUIPMENT INCLUDING BOTH THE REACTOR AND
 TURBINE GENERATOR. CIVIL CONSTRUCTION WILL BE BY
 A LOCAL CONTRACTOR. SITE PREPARATION BEGAN IN
 NOVEMBER, 1964.

REFERENCES NEWS RELEASES.

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF10

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NAME/OWNER	GOTAVERKEN PROJECT/GOTAVERKEN-SWEDEN
DESIGNER	GOTAVERK., SWEDEN
PURPOSE	TANKER PROPULSION
TYPE	PWR
POWER MWE(MWT)	30,000 SHP
CRITICAL	DESIGN AND DEVELOPMENT
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM METAL
FUEL GEOMETRY	SLUGS
FUEL ENRICH.	1 PER CENT U-235 OR SMALL ADDITION OF PLUTONIUM
FUEL ASSEMBLY	ROTATING FUEL ELEMENTS
FUEL CHARGE	24 TONS URANIUM
CONTROL	NEUTRON ABSORPTION BY SHIELDS INCORPORATED IN THE FUEL CLADDING TUBE.
CONTAINMENT	VERTICAL STEEL CYLINDER IN WHICH THE PRESSURE VESSEL IS SUSPENDED
REMARKS	STUDY PROJECT, COOPERATION WITH BRITISH AND US B + W. PRIMARY SYSTEM, VERTICAL STEEL CYLINDER INSIDE OF WHICH THE PRESSURE VESSEL WOULD BE SUSPENDED. CORE DESIGN FEATURES ROTATING FUEL ELEMENTS WITH NEUTRON ABSORBENT SHIELDS COVERING A SECTION OF THE CYLINDER SURFACE TO CONTROL REACTOR OUTPUT. A 4-YEAR R AND D AGREEMENT ON A NUCLEAR SHIP HAS BEEN SIGNED BY THE NORWEGIAN INST. FOR ATOMIC ENERGY AND ATOMENERGI OF SWEDEN.
REFERENCES	FIRST SCANDINAVIAN PROJECT FOR TANKER NUCLEAR PROPULSION. FA ABADIE-MAUMERT ENERGIE NUCLEAIRE 2, 44-5 /JANUARY-FEBRUARY 1960/

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF12

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NAME/OWNER	APS-1 /SOVIET ATOMIC POWER STATION-1//USSR	
DESIGNER	USSR	
OPERATOR	USSR	
LOCATION	OBNINSK, USSR	
PURPOSE	POWER PROTOTYPE	
TYPE	PWR, PRESSURE TUBE	
POWER MWE(MWT)	5	30
CRITICAL	1954	
COOLANT	LIGHT WATER	
MODERATOR	GRAPHITE AND GRAPHITE REFLECTOR	
FUEL MATERIAL	URANIUM-MOLYBDENUM-MAGNESIUM ALLOY	
FUEL GEOMETRY	TUBES 0,9 CM. ID./1.36 CM. OD./170 CM. LONG	
FUEL CLADDING	SS INNER 0.4 MM, OUTER 0,2 MM THICK	
FUEL ENRICH.	5 PER CENT U-235	
FUEL ASSEMBLY	4 CYLINDERS, SQUARE ARRAY, AROUND CENTRAL SS PRESSURE TUBE, GRAPHITE SUPPORT STRUCTURAL MEMBER 128 FUEL CHANNELS.	
FUEL CHARGE	550 KG ENRICHED URANIUM	
SPECIFIC POWER	54,5 KW/KG ENRICHED URANIUM	
BURNUP(REFUEL)	20 PERCENT OF U-235 PARTIAL, ABOUT 2 MONTHS	
NEUTRON FLUX	THERMAL AVE. 5×10^{13}	
CONTROL	SHIM AND REGULATING RODS	
COOLANT TEMP.	INLET 190 C	OUTLET 300 C
COOLANT PRESS.	INLET 109 KG/SQ.CM OUTLET 100 KG/SQ. CM.	
REACTOR VESSEL	CARBON STEEL CYLINDER 320 MM. DIA., 15 MM. WALL THICKNESS	
CONTAINMENT	REACTOR HALL ONLY	

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PRESSURIZED LIGHT WATER REACTORS, FOREIGN

HF12

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REMARKS

THE REACTOR HAS A THERMAL COLUMN AND SIX CHANNELS
FOR IRRADIATION EXPERIMENTS. IT HAS BEEN IN USE
AS A TEST-BED FOR BELOYARSK REACTOR FUEL ELEMENTS.

REFERENCES

DIRECTORY OF NUCLEAR REACTORS.
VOLUME 1, POWER REACTORS, P. 3-8
INTERNATIONAL ATOMIC ENERGY VIENNA, 1959.

THE FIRST ATOMIC POWER STATION OF THE USSR,
DI BLOKHINTSEV, NA NIKOLAEV
INTL. CONF. ON THE PEACEFUL USES OF ATOMIC
ENERGY 3, 35-55 /1955/

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PRESSURIZED LIGHT WATER REACTORS, FOREIGN

HF13

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NAME/OWNER	SIBERIAN REACTOR STATION/USSR
DESIGNER	USSR
OPERATOR	USSR
LOCATION	TROITSK, USSR
PURPOSE	POWER, SIX-REACTOR COMPLEX
TYPE	PWR, SIX-REACTOR STATION PLANNED.
POWER MWE(MWT)	100
CRITICAL	1958 /1ST REACTOR/
COOLANT	LIGHT WATER
MODERATOR	GRAPHITE
FUEL MATERIAL	URANIUM METAL
FUEL GEOMETRY	RODS
FUEL CLADDING	ALUMINUM TUBES
FUEL ENRICH.	NATURAL
FUEL CHARGE	182,000 KG, URANIUM
COOLANT TEMP.	428 F
REMARKS	NO RECENT INFORMATION
REFERENCES	CATALOG OF NUCLEAR REACTORS. HS ISBN SECOND U.N. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY 8, 561-584 /1958/

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PRESSURIZED LIGHT WATER REACTORS, FOREIGN

HF14

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COOLANT TEMP. 262,5 C

COOLANT PRESS. 100 KG./SQ. CM.

REACTOR VESSEL STEEL CYLINDER 3,8 M. DIA./12 M. HIGH.
SS INNER CLADDING

CONTAINMENT WATER-FILLED CIRCULAR TANK, REACTOR VAULT.

REMARKS RATING FOR NO. 2 REACTOR IS 365 MWE, 1400 MWT.
FUEL WILL BE SS-CLAD URANIUM DIOXIDE ENRICHED
TO 2,5 - 3,5 PER CENT. BURNUP IS 30,000 MWD/T.
HUNGARY REPORTEDLY WILL IMPORT TWO 400-MWE
REACTORS OF THE VORONEZH TYPE, FOR OPERATION IN
1975-1976,REFERENCES THE RUSSIAN 420 MW POWER STATION,
NUCLEAR ENG. 2, 431-6 /1957/DIRECTORY OF NUCLEAR REACTORS, VOL. 1, P. 33-38
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1959.WORLD POWER REACTORS 1966 /CHART/
NUCLEAR ENGINEERING APRIL 1966,

NUCLEONICS WEEK JULY 14, 1966 P. 3

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF15

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NAME/OWNER	LENINGRAD POWER STATION/USSR
DESIGNER	USSR
OPERATOR	USSR
LOCATION	LENINGRAD, USSR
PURPOSE	POWER
TYPE	PWR, TWO-REACTOR STATION ORIGINALLY PLANNED
POWER MWE(MWT)	210 760
CRITICAL	PROJECT CANCELED
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE
FUEL GEOMETRY	RODS
FUEL CLADDING	ZIRCONIUM
FUEL ENRICH.	1.5 PER CENT U-235
REMARKS	STATION WAS TO HAVE BEEN SIMILAR TO THE VORONEZH STATION. THE PROJECT HAS BEEN DROPPED, PRESUMABLY BECAUSE OF CLOSE-IN SITING PROBLEMS.
REFERENCES	PRESSURIZED WATER REACTORS IN THE USSR, SA SKARTSOV SECOND U.N. INTL. CONF. ON THE PEACEFUL USES OF ATOMIC ENERGY 8, 415-20 /1958/

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF16

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NAME/OWNER TES-3 / USSR

DESIGNER USSR

OPERATOR USSR

LOCATION OBNISK, USSR

PURPOSE PORTABLE /PACKAGED/ POWER PLANT

TYPE PWR, MOBILE PLANT, PACKAGED.

POWER MWE(MWT) 1.5 12

CRITICAL 1961

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE DISPERSED IN MELTABLE ALLOY

FUEL ENRICH. HIGH

BURNUP(REFUEL) 250-DAY CORE LIFE

CONTROL RODS

COOLANT TEMP. INLET 275 C OUTLET 300 C

COOLANT PRESS. 130 ATM.

CONTAINMENT TRANSPORTABLE LEAD SHIELDING, SHIELD TANK LOCATION
IN TRENCH WITH OVERLAP AND WALLS OF FERRO-CONCRETE
AND GROUND COVER.REMARKS PLANT AND EQUIPMENT IS MOUNTED ON FOUR TRUCK
TRAILERS. TES-3 IS A 2-CIRCUIT STEAM-TURBINE
SET-UP, AND IS AUTOMATED FOR CHANGE IN POWER WITH
CHANGING TURBOGENERATOR OVERLOAD. TRAILERS ARE
EQUIPPED FOR MOVEMENT BY RAIL.REFERENCES ATOMIC ENERGY IN THE SOVIET UNION.
TRIP REPORT, U.S. ATOMIC ENERGY DELEGATION, MAY
1963.SMALL-GABARIT ATOMIC POWER PLANT TES-3
NM SINEV, OTHERS
3RD U.N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964. A/CONF. 28/P/310

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF17

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NAME/OWNER	LENIN SHIP REACTOR/USSR
DESIGNER	USSR
OPERATOR	USSR
LOCATION	NUCLEAR ICE-BREAKER LENIN
PURPOSE	SHIP PROPULSION
TYPE	PWR. 3-REACTOR PLANT.
POWER MWE(MWT)	SEE REMARKS 90
CRITICAL	OPERATION 1959. REFUELED IN SPRING, 1963.
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS
FUEL GEOMETRY	ROD, 6.1 MM. DIA., 1.6 M. ACTIVE HEIGHT
FUEL CLADDING	ZIRCONIUM ALLOY 0.75 MM. THICK. SEE REMARKS
FUEL ENRICH.	5 PER CENT U-235
FUEL ASSEMBLY	36-ROD BUNDLE IN CIRCULAR SHROUD, IN CONTAINMENT CHANNELS OF ZIRCONIUM ALLOY. 219 CHANNELS
FUEL CHARGE	80 KG. U-235
BURNUP(REFUEL)	11000-13000 MWD/T
CONTROL	BURNABLE POISON DISTRIBUTED IN CONTAINMENT CHANNELS. RODS.
COOLANT TEMP.	INLET 261 C OUTLET 317 C
REACTOR VESSEL	CYLINDRICAL, 2 M. OD. BY 5 M. HIGH, LOW-ALLOY STEEL WITH SS SHELL.
CONTAINMENT	STEEL AND LIMONITE CONCRETE PLUS SHIELDING.
REMARKS	WITH THREE REACTORS OPERATING, THE FULL POWER OF 40,000 SHP CAN BE OBTAINED, NORMALLY ONLY TWO REACTORS OPERATE. ON THE FIRST REFUELING, ONE REACTOR WAS CHARGED WITH STAINLESS STEEL CLAD

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF17

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ELEMENTS, TWO NEW ATOMIC ICEBREAKERS WILL HAVE 2
IMPROVED REACTORS EACH INSTEAD OF 3.

REFERENCES

A NUCLEAR ICE-BREAKER
AP ALEKSANDOV, OTHERS
SOVIET J. ATOMIC ENERGY 5. 1121-46 /1958/

USSR LENIN,
NUCLEAR ENG. 9. 364 AND FACING /OCTOBER 1964/

OPERATING EXPERIENCE OF THE ATOMIC POWER PLANT
ON THE ICE-BREAKER LENIN,
JJ APHRIKANTOV, OTHERS
3RD U.N. INTL. CONF. ON THE PEACEFUL USES OF
ATOMIC ENERGY, GENEVA, 1964,
A/CONF. 28/P/313

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF18

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NAME/OWNER SHIP REACTOR STUDIES /UK AEA

PURPOSE SHIP PROPULSION

REMARKS THE UK AEA HAS JOINED BELGONUCLEAIRE IN THE JOINT
DEVELOPMENT OF THE VULCAIN CONCEPT FOR NUCLEAR
SHIP PROPULSION. CURRENTLY ALL SHIP DESIGNS HAVE
BEEN REPORTED AS DROPPED EXCEPT THE VULCAIN
CONCEPT AND THE IRR /INTEGRAL BOILING REACTOR/,
A PRESSURE TUBE SYSTEM.

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF20

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NAME/OWNER	FDR /FORTSCHNITTLICHER DRUCKWASSERREAKTOR//GKSS OTTO HAHN	
DESIGNER	DEUTSCH BAW-INTERATOM. SEE REMARKS	
OPERATOR	GKSS-W GERMANY	
PURPOSE	SHIP PROPULSION, ORE CARRIER OTTO HAHN.	
TYPE	ADVANCED PWR, INTEGRAL DESIGN	
POWER MWE(MWT)	10,000-11,000 SHP	38
CRITICAL:	DEVELOPMENT AND CONSTRUCTION. SEA TRIALS 1967	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	ROD, 11,0 MM. DIA., ACT. LENGTH 1120 MM.	
FUEL CLADDING	SS TUBES, WALL THICKNESS 0,35 MM.	
FUEL ENRICH.	ZONE ENRICHMENT 2.5, 2.9, 3.5 AND 4.3 PER CENT U-235	
FUEL ASSEMBLY	226-ROD BUNDLES, 17X17 SQUARE, AND TRIANGULAR CORNER ASSEMBLIES. 16 FUEL ASSEMBLIES/CORE	
FUEL CHARGE	2.95 TONS URANIUM DIOXIDE	
BURNUP(REFUEL)	7200-14,000 MWD/T	3-YEAR CORE LIFE
NEUTRON FLUX	THERMAL AVE, 1×10^{13} FAST AVE, 7.5×10^{13}	
CONTROL	RODS, BORON CARBIDE-SS, AND BURNABLE POISON ZIRCONIUM BORIDE/ZIRCONIUM DIOXIDE	
COOLANT TEMP.	INLET 266 C	OUTLET 278 C
COOLANT PRESS.	63,5 KG/SQ. CM.	
REACTOR VESSEL	VESSEL OF FORGED RINGS, 2300 MM. DIA. / 8700 MM. HIGH, DIVIDED BY A CYLINDRICAL WALL INTO INNER AND OUTER SPACE.	
CONTAINMENT	VERTICAL CYLINDER 13.1 M. HIGH, 9.5 M. DIA., 30 MM	

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF20

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WALL THICKNESS.

REMARKS

AWARD WAS TO DEUTSCH B+W AND INTERATOM FOR THE U.S. B+W DEVELOPED CONSOLIDATED NUCLEAR STEAM GENERATOR. POWER PLANT WILL BE INSTALLED IN THE RESEARCH VESSEL OTTO HAHN, WHICH WAS LAUNCHED IN JUNE 1964. REACTOR INSTALLATION TARGET IS 1966, POWER OPERATION 1967.

REFERENCES

GERMANY-S NUCLEAR SHIP.
NUCLEAR ENG. 9.8 /JANUARY 1964/

ADVANCED PRESSURIZED-WATER REACTOR FOR FIRST
GERMAN NUCLEAR ENERGY SHIP,
W KLIEFOTH
ATOMKERNENERGIE 8. 458-60 /DEC. 1963/

THE REACTOR PLANT OF THE RESEARCH SHIP OF
GESELLSCHAFT FOR KERNENERGIEVERWERTUNG IN
SCHIFFBAU U. SCHIFFFAHRT MBH.
W WIEBE, OTHERS
3RD U.N. INTL. CONF. PEACEFUL USES OF ATOMIC
ENERGY, GENEVA, 1964.
A/CONF. 28/P/540

NUCLEAR SHIP PROPULSION
EURO-NUCLEAR 2/4/. 174-8 /APRIL 1965/

GERMANY-S NUCLEAR SHIP
C SALANDER, D ULKEN /GKSS/
NUCLEAR ENG. 10. 324-9 /SEPT. 1965/

EXPERIMENTAL ORE CARRIER OTTO HAHN
ENGINEER 219. 54-6 /JAN. 1, 1965/

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF21

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NAME/OWNER	OBRIGHEIM NUCLEAR STATION/KBWP, W. GERMANY	
DESIGNER	SIEMENS-SCHUCKERTWERKE	
OPERATOR	KERNKRAFTWERK BADEN-WURTTENBERG	
LOCATION	OBRIGHEIM AM NECKAR, W. GERMANY	
PURPOSE	POWER	
TYPE	PWR, CLOSED LOOP	
POWER MWE(MWT)	283	907.5
CRITICAL	TARGET 1968	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE	
FUEL GEOMETRY	ROD, 2.6 M, ACTIVE LENGTH	
FUEL CLADDING	ZIRCALOY TUBES	
FUEL ENRICH.	3 PER CENT U-235	
FUEL ASSEMBLY	196-ROD ASSEMBLY, 16X16 121 ASSEMBLIES/CORE	
FUEL CHARGE	35.7 TONS URANIUM	
BURNUP(REFUEL)	24000 MWD/T	
CONTROL	RODS, BORON CONCENTRATION IN COOLANT /CHEMICAL SHIM/	
COOLANT TEMP.	INLET 281.5 C	OUTLET 309 C
COOLANT PRESS.	145 KG/SQ. CM. ABS.	
CONTAINMENT	DOUBLE CONTAINMENT BUILDING, GAS-TIGHT, STEEL SPHERE AND SHIELDING.	
REMARKS	ORDER PLACED JULY 1964	
REFERENCES	OBRIGHEIM NUCLEAR POWER STATION EURONUCLEAR 2, 145-6 /MARCH 1965/	

JANUARY 1967

BNWL-326

PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF22

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NAME/OWNER	NOK POWER STATION/NOK, SWITZERLAND BEZNAU POWER STATION / MUHLEBERG	
DESIGNER	WESTINGHOUSE ELECTRIC CORP.	
OPERATOR	NOK /NORTHEAST SWISS POWER CO./	
LOCATION	BEZNAU, SWITZERLAND	
PURPOSE	POWER	
TYPE	PWR, CLOSED CYCLE, TWO-LOOP SYSTEM	
POWER MWE(MWT)	350	1130
CRITICAL	TARGET 1969	
COOLANT	LIGHT WATER	
MODERATOR	LIGHT WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS	
FUEL GEOMETRY	ROD	
FUEL CLADDING	ZIRCALOY	
FUEL ENRICH.	3.08 PER CENT U-235	
FUEL ASSEMBLY	ROD BUNDLE 120 ASSEMBLIES/CORE SPRING-CLIP ASSEMBLY	
FUEL CHARGE	39,945 KG. URANIUM	
CONTROL	SILVER-INDIUM-CADMIUM RODS, SS CLAD CHEMICAL SHIM	
COOLANT PRESS.	210.4 PSIA	
REACTOR VESSEL	STEEL CYLINDER	
CONTAINMENT	ZERO-LEAKAGE DOUBLE CONTAINMENT, OUTER CONCRETE SHIELD, STEEL LINER, INTERMEDIATE AIR ZONE, INNER STEEL PRESSURE CONTAINMENT 34 M. ID. REACTOR VESSEL IS IN A CONCRETE CAVE IN THE REACTOR FLOOR	
REMARKS	THE SINGLE REACTOR WILL BE EQUIPPED WITH TWO TURBINES. CONSTRUCTION WILL START IN THE FALL OF	

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF22

1965, TARGET 1969.

REFERENCES

THE NOK NUCLEAR POWER STATION,
EURONUCLEAR 2, 430-33 /SEPT. 1965/

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF23

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NAME/OWNER ZAN THAN NUCLEAR SHIP/CHINA
 CHINESE DEMOCRATIC REPUBLIC

DESIGNER NUCLEAR COMMITTEE OF TIEN-TSIN

PURPOSE SHIP PROPULSION, COASTAL VESSEL

TYPE PWR.

POWER MWE(MWT) 180

CRITICAL CONSTRUCTION 1964 AT TIEN-TSIN

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL GEOMETRY TUBE

FUEL CLADDING ZIRCONIUM ALLOY TUBE

FUEL ENRICH. 1.7 PER CENT U-235

FUEL ASSEMBLY CORE CONSISTS OF 98 FUEL CELLS

FUEL CHARGE 8380 KG. URANIUM

CONTROL CRUCIFORM RODS AND TEMPERATURE CONTROL

REACTOR VESSEL CYLINDER, HEMISPHERICAL BOTTOM, TOP COVER

CONTAINMENT FOUR CONCENTRIC CYLINDRICAL THERMAL SHIELDS, SS.

REMARKS PROPUSION FOR A 20,000 TON COASTAL VESSEL
 SPEED 23.5 KNOTS

REFERENCES PEACEFUL USES OF NUCLEAR ENERGY IN THE CHINESE
 DEMOCRATIC REPUBLIC,
 LI YANG
 ENERGIE NUCLEAIRE 8, 40-3 /JAN.-FEB. 1966/

JANUARY 1967

BNWL-326

PRESSURIZED LIGHT WATER REACTORS, FOREIGN

HF24

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NAME/OWNER MIHAMA NUCLEAR STATION/KANSAI ELEC. POWER, JAPAN
KANSAI TSURUGA

DESIGNER WESTINGHOUSE ELECTRIC CORP.

OPERATOR KANSAI ELECTRIC POWER CO., JAPAN

LOCATION NIU, ON TSURUGA PENINSULA, HONSHU, JAPAN

PURPOSE POWER

TYPE PWR

POWER MWE(MWT) 325

CRITICAL CONSTRUCTION 1967
TARGET 1970

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

REMARKS CONTRACT AWARD MAY 1966

REFERENCES NUCLEONICS WEEK MAY 5, 1966 P. 2-3
NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF25

NAME/OWNER EGYPTIAN POWER-DESALINATION STATION/UAR ATOMIC
ENERGY ESTAB.

DESIGNER WESTINGHOUSE ELECTRIC CORP.

OPERATOR UNITED ARAB REPUBLIC

LOCATION MEDITERRANEAN COAST NEAR BURG EL-ARAB, UAR

PURPOSE POWER AND DESALINATION

TYPE	PWR
1	1
2	2
3	3
4	4
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96	96
97	97
98	98
99	99
100	100

POWER MWE(MWT) 150

REMARKS WILL PRODUCE 5.3 MGD DESALTED WATER

REFERENCES NUCLEONICS WEEK JUNE 30, 1966 P. 1
 NEWS RELEASE

JANUARY 1967

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PRESSURIZED LIGHT WATER REACTORS, FOREIGN

HF26

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NAME/OWNER RHEINSBERG STATION, EAST GERMANY

DESIGNER USSR

LOCATION RHEINSBERG, E. GERMANY

TYPE PWR, NOVO-VORONEZH TYPE

POWER MWE(MWT) 70

CRITICAL REPORTEDLY ON-LINE IN 1966

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE

FUEL CLADDING ZIRCONIUM

FUEL ENRICH. SLIGHT

REFERENCES NEWS RELEASE

JANUARY 1967

BNWL=326

PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF27

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NAME/OWNER	FLANDERS STATION/EBES, BELGIUM
OPERATOR	SOCIETE REUNIES D-ENERGIE DU BASSIN DE L ESCANT. EBES
LOCATION	DOELL, NEAR ANTWERP, BELGIUM
PURPOSE	POWER
TYPE	PWR
POWER MWE(MWT)	600
CRITICAL	TARGET 1971
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
REMARKS	BIDS UNDER EVALUATION, AUG, 1966
REFERENCES	NUCLEONICS WEEK AUG, 11, 1966 P. 6 NEWS RELEASE

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PRESSURIZED LIGHT WATER REACTORS. FOREIGN

HF28

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NAME/OWNER COMPACT PWR/FAIREY ENGINEERING

DESIGNER FAIREY ENGINEERING, UNITED KINGDOM

PURPOSE POWER AND/OR STEAM, REMOTE LOCATIONS

TYPE PWR, INTEGRAL DESIGN

POWER MWE(MWT) 20-60

COOLANT LIGHT WATER

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL CLADDING SS CANS

BURNUP(REFUEL) 2-3 YEARS

CONTROL BURNABLE POISON IN CORE

REACTOR VESSEL CONCRETE VESSEL CONTAINING CORE AND HEAT EXCHANGER

REMARKS FAIREY ENG. IS PREPARED TO PROVIDE EITHER A
PACKAGE DEAL OR COOPERATION WITH LOCAL INDUSTRY
FOR INSTALLATION OF THE PACKAGE PLANT

REFERENCES APPLIED ATOMICS SEPT. 21, 1966 P. 6
NEWS RELEASE

STEAM OR SUPERCRITICAL WATER COOLED REACTORS

DOMESTIC

JANUARY 1967

ANAL-12

STEAM OR SUPERCRIT. WATER COOLED REACTORS, DOMESTIC

1966

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NAME/OWNER GBSR /GRAPHITE BOILING-SUPERHEAT REACTOR/AT

DESIGNER ATOMICS INTERNATIONAL

PURPOSE POWER

TYPE BOILING-SUPERHEATING, PRESSURE TUBE.

POWER MWE(MWT) 318 760

CRITICAL CONCEPTUAL DESIGN

COOLANT LIGHT WATER AND STEAM

MODERATOR GRAPHITE, GRAPHITE REFLECTOR

FUEL MATERIAL URANIUM CARBIDE IN GRAPHITE MATRIX

FUEL GEOMETRY SLUGS 4.0 IN. DIA./3 FT. LONG

FUEL CLADDING SILICON CARBIDE COATING

FUEL ENRICH. 2.8 PER CENT U-235 AVERAGE

FUEL ASSEMBLY BOILING, 480 FUEL CHANNELS
SUPERHEAT, 440 FUEL CHANNELS
REHEAT, 350 FUEL CHANNELS
10 PODS/CHANNEL, STACKED. EXTRA FUEL
CHANNELS ARE PROVIDED.

FUEL CHARGE 120,000 KG. URANIUM

SPECIFIC POWER 6.33 KW/KG URANIUM

BURNUP(REFUEL) 25,000 MWD/MTU CONTINUOUS

CONTROL RODS, BORON CARBIDE ABSORBER

COOLANT TEMP. INLET 613 C OUTLET 645 C /BOILER/
INLET 645 C OUTLET 1060 C /SUPERHEATER/
INLET 660 C OUTLET 2000 C /REHEATER/

COOLANT PRESS. BOILER 2200 PSIG
SUPERHEATER 2120
REHEATER 500

REACTOR VESSEL STEEL VESSEL 51.31 FT. ID./62.5 FT. HIGH.
CONCRETE SHIELDING ON SIDES, WITH BURIED COOLING
COILS, FIRE BRICK AGAINST INTERIOR SURFACE OF
CONTAINMENT TANK.

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. DOMESTIC

ID01

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CONTAINMENT

PRESSURE-SUPPRESSION. CONVENTIONAL REINFORCED
CONCRETE OR CARBON STEEL STRUCTURE.

REMARKS

EACH GRAPHITE BLOCK CONTAINS 4 VERTICAL FUEL
CHANNELS, EACH SURROUNDED BY 4 COOLANT TUBES.
CORE IS 3-REGION, CENTRAL BOILING, INNER ANNULAR
SUPERHEATING, AND OUTER ANNULAR REHEAT REGIONS.
WATER CIRCULATES IN THE CENTRAL SECTION THROUGH
THE COOLANT TUBES, STEAM IS SEPARATED IN A STEAM
DRUM AND RETURNS TO THE SUPERHEAT REGION. FROM
THERE IT FLOWS TO A HIGH PRESSURE TURBINE THROTTLE
RETURNING TO THE REACTOR TO BE REHEATED IN THE
ANNULAR REHEAT REGION. BOILER REGION PIPING IS
PH 15-7 MO OR ZIRCALOY-2, IN THE SUPERHEAT AND
REHEAT REGIONS INCONEL-X.

REFERENCES

STEAM-COOLED POWER REACTOR EVALUATION,
GRAPHITE MODERATED, BOILING WATER, STEAM-SUPERHEAT
REACTOR.
ATOMICS INTERNATIONAL
NAA-SR-6100 /SEPT. 1961/

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, DOMESTIC

ID02

* * * * *

NAME/OWNER CBSR /COUPLED BREEDING SUPERHEATING REACTOR//ANL

DESIGNER ARGONNE NATIONAL LABORATORY

PURPOSE POWER

TYPE PWR, STEAM COOLANT, PRESSURE TUBE, FAST-THERMAL BREEDER.

POWER MWE(MWT) 65 216

CRITICAL CONCEPTUAL DESIGN

COOLANT THERMAL CORE LIGHT WATER
FAST CORE SUPERHEATED STEAM

MODERATOR LIGHT WATER

FUEL MATERIAL FAST

ZONE 1. PLUTONIUM DIOXIDE AND DEPLETED URANIUM
DIOXIDE PELLETS, 0.287 CM. DIA.

ZONE 2,3A AND 3B /RADIAL BUFFER, UPPER AXIAL
FAST BLANKET, LOWER AXIAL
FAST BLANKET/, DEPLETED
URANIUM DIOXIDE PELLETS,
0.856 CM. DIA.

THERMAL

ZONE 5. NATURAL URANIUM DIOXIDE PELLETS, 0.673
CM. DIA.

ZONE 6-7 /RADIAL THERMAL BLANKET/, ZONE 6,
DEPLETED URANIUM DIOXIDE PELLETS
0.673 CM. DIA. ZONE 7, DEPLETED
URANIUM, 1.214 CM. DIA.

ZONE 8A-8B /UPPER AXIAL THERMAL BLANKET, LOWER
AXIAL THERMAL BLANKET/, DEPLETED
URANIUM DIOXIDE PELLETS 0.673 CM.

FUEL GEOMETRY FAST

ZONE 1. ROD 0.318 CM. DIA
ZONES 2-3A,3B. ROD 0.952 CM. DIA.

THERMAL

ZONE 5-6. ROD. 0.785 CM. DIA.
ZONE 7. ROD. 1.407 CM. DIA.
ZONE 8A-8B. ROD 0.785 CM. DIA.

FUEL CLADDING FAST. STAINLESS STEEL.

ZONE 1. 0.0127 CM. THICK
ZONE 2, 3A,3B. 0.043 CM. THICK

THERMAL. ZIRCALOY-2.

ZONE 5,6,8A,8B. 0.051 CM. THICK

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, DOMESTIC

ID02

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ZONE 7. 0.089 CM. THICK

FUEL ASSEMBLY FAST, HEXAGONAL BUNDLES /CANS/.

ZONE 1. 547-RODS/BUNDLE

ZONES 2, 3A, 3B. 61-ROD BUNDLE

TOTAL RODS.

ZONE 1. 26,256

ZONE 2. 793

ZONE 3A. 3721

ZONE 3B. 3721

THERMAL

ZONES 5, 6, 8A, 8B. 61 RODS/PRESSURE TUBE.

ZONE 5. 42 PRESSURE TUBES.

ZONE 7. 246.

ZONE 8A AND 8B. 66 EACH

ZONE 7. 19 RODS/PRESSURE TUBE. 246 PRESSURE TUBES.

FUEL CHARGE FAST CORE 242 KG. PLUTONIUM

BURNUP(REFUEL) FAST CORE 1 PER CENT

CONTROL RODS

COOLANT TEMP. INLET 308 C OUTLET 453 C AVERAGE

COOLANT PRESS. 95 ATM.

REACTOR VESSEL CARBON STEEL, SS CLAD, 228 CM. ID./648 CM. LONG.

REMARKS A HEAVY WATER SYSTEM WAS FIRST CONSIDERED. OTHER CONCEPTS INCLUDED ONE IN WHICH ALL STEAM FOR SUPERHEATING WAS PRODUCED IN THE THERMAL REGION /THERMAL-FAST SYSTEM/ WITH HEAVY WATER AS COOLANT, AND ONE IN WHICH NO STEAM IS GENERATED IN THE REACTOR, THE THERMAL PORTION OF THE COUPLED REACTOR ACTING AS A PRESSURIZED WATER PREHEATER FOR EXTERNAL BOILERS /FAST-THERMAL SYSTEM/.

REFERENCES COUPLED FAST-THERMAL BREEDER,
R AVERY
NUCLEAR SCI. ENG. 3,129 /1958/

CONCEPTUAL DESIGN OF A COUPLED BREEDING
SUPERHEATING REACTOR CBSR.
R AVERY, OTHERS
ANL-6286 /MARCH 1961/

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. DOMESTIC

1003

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NAME/OWNER SCBR /STEAM COOLED BREEDER REACTOR//BAW-ECNG

DESIGNER BABCOCK AND WILCOX

PURPOSE POWER

TYPE SUPERCRITICAL STEAM COOLED FAST BREEDER, DIRECT OR
INDIRECT CYCLE, PRESSURE TUBE.

POWER MWE(MWT) 1000 2320

CRITICAL CONCEPTUAL DESIGN

COOLANT STEAM, LIGHT/HEAVY WATER
CIRCULATING COOLANT HEAVY WATER

MODERATOR HEAVY WATER

FUEL MATERIAL URANIUM-PLUTONIUM OXIDE
BLANKET URANIUM DIOXIDE

FUEL GEOMETRY ROD, 0.23 IN. DIA.

FUEL CLADDING INCONEL, INCOLOY, HASTELLOY-X, 19-9 DL CONSIDERED.

FUEL ENRICH. BLANKET NATURAL URANIUM

FUEL ASSEMBLY 504-ROD BUNDLE WITH 1 BORON CONTROL ROD
108 ASSEMBLIES/CORE
CORE IS COMPLETELY SURROUNDED BY BLANKET

SPECIFIC POWER 0.91 MW/KG PLUTONIUM

BURNUP(REFUEL) 80,000 MWD/T

CONTROL ROD

COOLANT TEMP. INLET 750 F OUTLET 1000 F

COOLANT PRESS. 3650 PSI

REMARKS CONCEPTUAL DESIGN OF A 1000 MWE DIRECT CYCLE
REACTOR HAS BEEN COMPLETED. ECNG, FORMED BY BAW
AND 14 UTILITIES, WILL DEVELOP A 3500 PSI STEAM
COOLED BREEDER FOR THE PRODUCTION OF LOW-COST
ELECTRICAL ENERGY. LONG-RANGE PROGRAM IS EXPECTED
TO LEAD TO A 1000 MWE DEMONSTRATION REACTOR IN THE
1970-S.
SEE ALSO NDA STUDY 1D-8

REFERENCES STEAM COOLED REACTOR UNDER STUDY.

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. DOMESTIC

ID03

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ELECTRICAL WORLD 162.40 /AUG. 24, 1964/

STEAM COOLED BREEDER REACTORS.

MC EDLUND, OTHERS

FAST REACTOR TECHNOLOGY, NATIONAL TOPICAL MEETING

APRIL 26-28, 1965.

AMERICAN NUCLEAR SOC.

ANS-100 P. 85-88

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, DOMESTIC

ID04

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NAME/OWNER	VESR /VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR/ GE-ESADA
DESIGNER	GENERAL ELECTRIC COMPANY
OPERATOR	GENERAL ELECTRIC COMPANY
LOCATION	VALLECITOS ATOMIC LABORATORY, CALIF.
PURPOSE	EXPERIMENTAL AND TESTING, SUPERHEAT FUEL DEVELOPMENT.
TYPE	STEAM COOLED REACTOR, SEPARATE SUPERHEAT
POWER MWE(MWT)	12.5
CRITICAL	NOV. 1963. FULL POWER MAY 1964
COOLANT	SATURATED STEAM. SEE REMARKS
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE HOLLOW PELLETS
FUEL GEOMETRY	ANNULAR RODS
FUEL CLADDING	SS INNER AND OUTER, CONCENTRIC TUBES.
FUEL ENRICH.	3.6 PER CENT U-235
FUEL ASSEMBLY	9-ROD BUNDLE, ENCLOSED IN PROCESS TUBE 32 BUNDLES/CORE
FUEL CHARGE	5300 POUNDS URANIUM DIOXIDE
BURNUP(REFUEL)	5000 MWD/T FIRST CORE
COOLANT TEMP.	545 F
COOLANT PRESS.	1000 PSI
REACTOR VESSEL	STEEL VESSEL
CONTAINMENT	CONVENTIONAL STEEL CONTAINMENT STRUCTURE INTEGRATED, LEAK-TIGHT VESSEL
REMARKS	THE SADE /SUPERHEAT ADVANCED DEMONSTRATION EXPERIMENT/ PROGRAM PRODUCED SUPERHEATED STEAM BY DIRECT NUCLEAR MEANS IN 1959. THE ESADA REACTOR IS DESIGNED TO TEST A LARGE NUMBER OF

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. DOMESTIC

ID04

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EXPERIMENTAL FUEL ELEMENTS IN AN OPERATING REACTOR ENVIRONMENT. THE MARK 2 CORE DESIGN CONSISTS OF A 6X6 ARRAY OF 32 FUEL BUNDLES. COMBINATION BOILING-SUPERHEATING ELEMENTS WERE ALSO STUDIED. 300 AND 600 MWE CONCEPTS HAVE BEEN INVESTIGATED. THE 600 MWE REACTOR USING SOLID-ROD ELEMENTS. COOLING IS BY A COMBINATION OF MODERATOR BOILING AND FORCED CONVECTION COOLING WITH SATURATED STEAM
SEE ID05

REFERENCES

THE REACTOR AND PLANT DESIGN FOR ESADA AND EVSR.

J BARNARD

ASME PREPRINT 61-WA-223 /1961/

PRELIMINARY HAZARDS SUMMARY REPORT FOR THE VALLECITOS SUPERHEAT REACTOR.

GL MURRAY, ED.

GEAP-3642 /FEB. 1961/

THE ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR.

DH IMHOFF

POWER REACTOR EXPERIMENTS VOL.2, P. 53-79

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1962.

FINAL HAZARDS SUMMARY REPORT FOR THE ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR.

JL MURRAY, ED.

APED-3958 /OCT. 1, 1962/

DESIGN AND OPERATING EXPERIENCE OF THE ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR.

W IANNI, OTHERS

APED-4784 /FEB. 1965/

PRELIMINARY HAZARDS SUMMARY REPORT FOR THE VALLECITOS SUPERHEAT REACTOR

JL MURRAY

GEAP-4643 /FEB. 1, 1961/

BNWL = 326

1105

REMARKS	THE BWR IS A FORCED CIRCULATION SINGLE CYCLE PRESSURE VESSEL REACTOR WITH INTERNAL STEAM SEPARATION. SUPERHEAT REACTOR IS A SINGLE-PASS
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STEAM OR SUPERCRIT. WATER COOLED REACTORS, DOMESTIC

ID05

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REACTOR. THE BWR, A 1203 MWT PLANT, DELIVERS
STEAM TO THE SUPERHEAT REACTOR. BWR FUEL IS
URANIUM DIOXIDE WITH SS CLADDING. A PRELIMINARY
STUDY CONCERNED A 300 MWE PLANT USING ANNULAR FUEL
RODS, BOTH DOUBLE PASS AND ANNULAR PASS ELEMENTS
BEING STUDIED.

REFERENCES

STEAM-COOLED POWER REACTOR EVALUATION FOR 300 MWE
SEPARATE SUPERHEAT REACTOR.
GENERAL ELECTRIC CO, APED
GEAP-3589 /REV. 1/ /NOV. 1960/

DESIGN STUDY OF A 600 MWE BOILING WATER-SEPARATE
SUPERHEAT REACTOR PLANT.
RA SCHMIDT, OTHERS
GEAP-4057 /SEPT. 1962/

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, DOMESTIC

1006

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NAME/OWNER FSPPR /FAST SUPERCRITICAL PRESSURE POWER REACTOR/
DESIGNER GENERAL ELECTRIC COMPANY
PURPOSE POWER
TYPE SUPERCRITICAL STEAM COOLED FAST REACTOR, DIRECT
CYCLE.
POWER MWE(MWT) 300 677
CRITICAL CONCEPTUAL DESIGN
COOLANT LIGHT WATER STEAM /SUPERCRITICAL/
MODERATOR YTTRIUM OR ZIRCONIUM HYDRIDE CORE SUBDIVIDERS, THE
INNER CORE IS UNMODERATED.
FUEL MATERIAL DEPLETED URANIUM DIOXIDE-PLUTONIUM DIOXIDE
FUEL GEOMETRY MASSIVE FUEL ASSEMBLY PIERCED BY COOLANT TUBES,
5 FT. ACT. LENGTH.
FUEL CLADDING RENE-41, RENE-41 COOLANT TUBES.
FUEL ENRICH. 3.8 PER CENT PLUTONIUM
FUEL ASSEMBLY MASSIVE CERAMIC ELEMENT, TRIANGLE OR TRAPEZOID,
PIERCED BY HIGH-PRESSURE COOLANT TUBES. EACH
ELEMENT INCORPORATES AXIAL BLANKET SECTIONS.
72 ELEMENTS/CORE.
42 ARE FUEL-BEARING, 30 ARE RADIAL BLANKET
ELEMENTS.
SEE REMARKS.
FUEL CHARGE DEPLETED URANIUM 30,895 KG., PLUTONIUM 1559 KG.
SPECIFIC POWER 50 KW/KG URANIUM + PLUTONIUM
BURNUP(REFUEL) 82,700 MWD/T SHUT-DOWN
IN TANDEM /TWO-REACTOR PLANT/,
ONE REACTOR OPERATES WHILE
OTHER IS BEING REFUELED.
CONTROL RODS, SS-BORON
COOLANT TEMP. 1050 F INITIAL TURBINE THROTTLE CONDITIONS.
COOLANT PRESS. 3515 PSIA INITIAL TURBINE THROTTLE CONDITIONS.
REACTOR VESSEL SS TANK CONTAINING THE SEGMENTED CORE.

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. DOMESTIC

ID06

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CONTAINMENT STEEL BUILDING, PRESSURE-SUPPRESSION.

REMARKS THE REACTOR IS COMPOSED OF 7 RADIAL REGIONS. THE CORE IS 5 FT. HIGH /5.28 FT. DIA., SURROUNDED BY RADIAL AND AXIAL BLANKETS EACH 0.6 FT. THICK. THIN LAYERS OF YTTRIUM OR ZIRCONIUM HYDRIDE SUBDIVIDE THE SEGMENTS, WITH A LAYER OF U-238 AS ABSORBING MATERIAL ON EACH SIDE OF THE MODERATING ELEMENT TO FORM AN ANNULAR FLUX TRAP. FOUR CONCENTRIC REGIONS ARE THE RADIAL BLANKET, FIRST CORE, AND SECOND CORE, SEPARATED BY THE MODERATOR-ABSORBER, AND THE UNMODERATED 3RD, OR CENTRAL CORE THERE ARE PROVISIONS FOR DUAL-REACTOR INSTALLATION AND REMOTE FUEL HANDLING. CONCEPT IS BASED ON THE SSPR DESIGN.

REFERENCES ECONOMIC EVALUATION OF A 300 MWE SUPERCRITICAL POWER REACTOR /SSPR/.

H HARTY, OTHERS

HW-68420 /REV./ /JUNE 1961/

SEGMENTED CORE DESIGN FOR A SUPERCRITICAL PRESSURE WATER-COOLED FAST REACTOR,

RE PETERSON, SL STEWART

PROC. CONF. ON BREEDING, ECONOMICS AND SAFETY IN LARGE FAST POWER REACTORS. OCT. 7-10, 1963,

ANL-6792 P. 539-552

HW-SA-3149 /OCT. 3, 1963/

ECONOMIC EVALUATION OF A 300 MWE FAST SUPERCRITICAL PRESSURE POWER REACTOR,

DT AASE, OTHERS

HW-78953 /DEC. 9, 1963/

FAST SUPERCRITICAL WATER REACTOR

POWER REACTOR TECHNOLOGY 8, 186-93 /SUMMER 1965/

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STEAM OR SUPERCRIT, WATER COOLED REACTORS, DOMESTIC 1007
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NAME/OWNER	MSR /MIXED SPECTRUM SUPERHEAT REACTOR//GE
DESIGNER	GENERAL ELECTRIC COMPANY
LOCATION	CRITICAL ASSEMBLY AT VALLECITOS LAB., CALIF.
TYPE	STEAM COOLED BWR, TWO-REGION, FAST CORE
POWER MWE(MWT)	75
CRITICAL	DEVELOPMENT. CRITICAL ASSEMBLY DEC, 1963
COOLANT	LIGHT WATER AND STEAM
MODERATOR	LIGHT WATER. FAST CORE UNMODERATED
FUEL MATERIAL	BOILING REGION URANIUM DIOXIDE FAST CORE PLUTONIUM DIOXIDE IN DEPLETED URANIUM DIOXIDE BUFFER DEPLETED URANIUM
FUEL GEOMETRY	ROD
FUEL CLADDING	SS
FUEL ENRICH.	BOILING REGION SLIGHT FAST CORE 19.6 PER CENT

REMARKS
SATURATED STEAM GENERATED IN THE BOILING REGION
PASSES THROUGH AN INTERNAL STEAM SEPARATING SYSTEM
AND GOES THROUGH THE INNER SUPERHEATING REGION OF
THE CORE. IN THE 75 MWE PROTOTYPE THE FAST CORE
IS ROUND, THE FUEL HEXAGONAL. THE MIXED SPECTRUM
CRITICAL ASSEMBLY /MSCA/ WAS STARTED UP IN DEC.
1963, AND THE FAST SPECTRUM SUPERHEATER LOADED
IN MAY 1964, AT VALLECITOS. MSCA IS A SINGLE CORE
REACTOR WITH TWO SEPARATE FUEL REGIONS.

REFERENCES

STEAM COOLED POWER REACTOR EVALUATION,
MIXED SPECTRUM SUPERHEATER,
B WOLFE
GEAP-3590 /REV.1/ /NOV. 1960/
CONCEPTUAL DESIGN FOR A 75 MWE MIXED SPECTRUM
SUPERHEATING REACTOR POWER PLANT.
GV BRYNSVOLD, OTHERS
GEAP-4016 /FEB. 25, 1962/

JANUARY 1967

BNWL-326

STEAM OR SUPERCRIT. WATER COOLED REACTORS. DOMESTIC

ID08

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NAME/OWNER STEAM COOLED FAST REACTOR STUDY/NDA

DESIGNER NUCLEAR DEVELOPMENT CORPORATION OF AMERICA

PURPOSE POWER

TYPE STEAM COOLED FAST BREEDER, FORCED CIRCULATION,
DIRECT CYCLE.

POWER MWE(MWT) 300 840

CRITICAL FEASIBILITY STUDY, CONCEPTUAL DESIGN

COOLANT STEAM, LIGHT AND HEAVY WATER STUDIED.

MODERATOR NONE

FUEL MATERIAL URANIUM/PLUTONIUM DIOXIDE PELLETS.
BLANKET DEPLETED URANIUM DIOXIDE

FUEL GEOMETRY RODS 0.25 IN. DIA., 5 FT. ACT. LENGTH + BLANKET

FUEL CLADDING INCONEL-X TUBES 0.015 IN. THICK.
BLANKET SS

FUEL ENRICH. 15.4 PER CENT
BLANKET, DEPLETED URANIUM

FUEL ASSEMBLY CORE, 127-ROD CLUSTER
AXIAL AND RADIAL BLANKET, 37-ROD CLUSTER
326 CORE ASSEMBLIES
256 BLANKET ASSEMBLIES

SPECIFIC POWER 0.50 MWT/KG PLUTONIUM-239

BURNUP(REFUEL) 33,300 MWD/T PARTIAL, FUEL SHIFT

CONTROL BORON CARBIDE RODS

COOLANT TEMP. 945 F

COOLANT PRESS. 1400 PSIG

REACTOR VESSEL STEEL PLATE VESSEL, SS CLAD.
10.7 FT. ID./31 FT. HIGH.

REMARKS URANIUM / THORIUM DIOXIDE FUEL WAS ALSO STUDIED.

REFERENCES STEAM-COOLED POWER REACTOR EVALUATION, STEAM
COOLED FAST BREEDER REACTOR.

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, DOMESTIC

ID08

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G SOFER, OTHERS

NDA-2148-4 /APRIL 1961/

CONCEPTUAL DESIGN AND ECONOMIC EVALUATION OF A
STEAM-COOLED FAST BREEDER REACTOR.

G SOFER, OTHERS

NDA-2148-5 /NOV. 1961/

THE NDA STEAM-COOLED FAST REACTOR CONCEPT.
NUCLEAR POWER 6, 75 /OCT. 1961/

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, DOMESTIC

1009

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NAME/OWNER SWR /STEAM-WATER REACTOR//NDA
 DESIGNER NUCLEAR DEVELOPMENT CORPORATION OF AMERICA
 PURPOSE POWER
 TYPE STEAM COOLED, HEAVY WATER MODERATED, PRESSURE TUBE
 /CALANDRIA/
 POWER MWE(MWT) 200 530
 CRITICAL FEASIBILITY STUDY
 COOLANT STEAM /LIGHT WATER FOG/
 MODERATOR HEAVY WATER
 FUEL MATERIAL URANIUM DIOXIDE PELLETS 0.750 IN. DIA./0.750 IN.
 LONG
 FUEL GEOMETRY ROD, 24 IN. ACTIVE LENGTH
 FUEL CLADDING SS 0.010 IN. THICK
 FUEL ENRICH. 1 PER CENT U-235
 FUEL ASSEMBLY 19-ROD BUNDLE, 2 BUNDLES/ASSEMBLY
 5 ASSEMBLIES/PRESSURE TUBE
 BUNDLES INCLUDE THERMAL INSULATION
 1260 BUNDLES/CORE
 REF. DESIGN 272 PRESSURE TUBES.
 FUEL CHARGE 9 METRIC TONS, URANIUM DIOXIDE
 BURNUP(REFUEL) 5500 MWD/T
 COOLANT TEMP. 1060 F
 COOLANT PRESS. 2015 PSIA
 REACTOR VESSEL ALUMINUM CALANDRIA, ZIRCALOY PRESSURE TUBES.
 CONTAINMENT CONCRETE BUILDING.
 REMARKS AN ALTERNATE DESIGN WAS STUDIED IN WHICH SATURATED
 WATER INSTEAD OF STEAM IS SUPPLIED, AND BOILING
 OCCURS IN THE CENTRAL REGION OF THE REACTOR-- A
 BOILING-SUPERHEATING SWR. FUEL AND COOLANT ARE
 WITHIN THE PRESSURE TUBES WHICH PASS THROUGH THE
 CALANDRIA-CONTAINED HEAVY WATER MODERATOR. A

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. DOMESTIC

ID09

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STUDY REVIEW BY ECNG AND BAW WAS DONE FOR NDA.
NDA IS ALSO ENGAGED IN A EURATOM PROJECT WITH
CISE /ITALY/ FOR THE DESIGN OF FOG-COOLED REACTORS
SEE ALSO ITALY CAN, IF03

REFERENCES

STEAM COOLED REACTOR FEASIBILITY STUDY. STEAM
WATER REACTOR /SWR/. VOL. 1 /SECTIONS 1-6/
VOL. 2 /SECTIONS 7,8/ FINAL REPORT.
EAST CENTRAL NUCLEAR GROUP, B * W /FOR NDA/
NDA-2562-1 /VOL. 1 AND 2/ /AUGUST 1958/

STEAM-COOLED POWER REACTOR EVALUATION. STEAM
COOLED HEAVY WATER MODERATED REACTOR.
G SOFER, OTHERS
NDA-2161-2 /APRIL 1961/

CAN-1, FOG COOLANT PROJECT.
M SILVESTRI, OTHERS
NUCLEONICS 19, 86-8 /JANUARY 1961/

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, DOMESTIC

ID10

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NAME/OWNER SWR /SUPERCRITICAL WATER REACTOR/
DESIGNER BATTELLE MEMORIAL INSTITUTE
PURPOSE UNDERSEA PROPULSION AND AUXILIARY POWER
POWER MWE(MWT) 250 KWE 1440 KWT
COOLANT SUPERCRITICAL LIGHT WATER
MODERATOR LIGHT WATER
FUEL MATERIAL URANIUM DIOXIDE
FUEL GEOMETRY FUEL COUPONS 40 MILS THICK IN SS PLATE
FUEL CLADDING SS 7 MILS THICK
FUEL ENRICH. FULL
FUEL ASSEMBLY 15-PLATE ELEMENT, SQUARE CAN
 45-ELEMENT CORE
FUEL CHARGE 64.8 KG. U-235
CONTROL SS-CLAD BORON CARBIDE VANES IN REFLECTOR
COOLANT TEMP. INLET 300 F OUTLET 1000 F
COOLANT PRESS. 4340 PSI
REMARKS THE BMI STUDY WAS CONCERNED WITH APPLICATION FOR
 PROPULSION AND AUXILIARY POWER IN A DEEP-
 SUBMERGENCE VEHICLE, CONSIDERED FOR MISSIONS
 TO 10,000 FT.
REFERENCES A SUPERCRITICAL WATER REACTOR FOR PROPULSION AND
 AUXILIARY POWER IN A DEEP SUBMERSIBLE RESEARCH
 VEHICLE,
 JW RAY, JW CHASTAIN
 MARINE TECHNOLOGY SOCIETY MEETING
 WASHINGTON, JUNE 1965

STEAM OR SUPERCRITICAL WATER COOLED REACTORS

FOREIGN

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. FOREIGN

1F01

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NAME/OWNER HERMES/BELGONUCLEAIRE-BELGIUM

DESIGNER BELGONUCLEAIRE, BELGIUM

PURPOSE POWER

TYPE STEAM COOLED, DIRECT CYCLE, FAST REACTOR.
PRESSURE TUBE, MODULAR, LOEFFLER CYCLE.

POWER MWE(MWT) 300 870

CRITICAL DESIGN CONCEPT

COOLANT DRY STEAM

FUEL MATERIAL URANIUM/PLUTONIUM DIOXIDE

FUEL GEOMETRY PINS 5.8 MM. OD.

FUEL CLADDING INCONEL, INCOLOY, HASTELLOY, NIMONIC, AND
RENE-41 STUDIED

FUEL ENRICH. 20 PER CENT PLUTONIUM-239

FUEL ASSEMBLY CLOSE-PACKED PRESSURE TUBES CONTAIN FUEL ELEMENTS.
151-PIN ASSEMBLY
MODULUS. CHANNEL DIA. 100 MM., HEXAGONAL TUBE
WITH CIRCULAR INNER CHANNEL.
MODULI FIT TOGETHER. A BUNDLE OR HYPERMODULES
MAKING UP THE CORE CONSISTS OF 7 CHANNELS
SEPARATED BY 3 MM. THICK WALLS

SPECIFIC POWER 150 KWE/KG FISSIONABLE MATERIAL

BURNUP(REFUEL) 30,000 MWD/T /CORE/ AND 5000 MWD/T /BLANKET/

COOLANT TEMP. INLET 315C
SUPERHEAT 540 C

REFERENCES HERMES FAST NEUTRON SUPERHEATER REACTOR,
G TAVERNIER, OTHERS
3RD U. N. INTL. CONF. PEACEFUL USES OF ATOMIC
ENERGY, GENEVA 1964. A/CONF. 28/P/516

HERMES-A MODULAR STEAM COOLED FAST REACTOR CONCEPT
G TAVERNIER, OTHERS
ANS-100 P. 99-103

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, FOREIGN

IF02

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NAME/OWNER FOG COOLED REACTOR STUDY/AECL, CANADA

DESIGNER ATOMIC ENERGY OF CANADA LTD. /AECL/

PURPOSE POWER

TYPE STEAM/SPRAY/ COOLED, DIRECT CYCLE, PRESSURE TUBE, HOT.

POWER MWE(MWT) 200

CRITICAL ECONOMIC STUDY

COOLANT LIGHT WATER STEAM OR SPRAY

MODERATOR HEAVY WATER

FUEL MATERIAL URANIUM DIOXIDE PELLETS

FUEL GEOMETRY RODS

FUEL CLADDING ZIRCALOY-2

FUEL ENRICH. NATURAL

FUEL ASSEMBLY 19-ROD BUNDLE

BURNUP(REFUEL) 8600 MWD/T

REACTOR VESSEL CALANDRIA, ZIRCONIUM ALLOY PRESSURE TUBES.

REMARKS THE PRESSURE TUBE IS SURROUNDED BY AN INSULATING GAS, IN TURN SURROUNDED BY A CALANDRIA TUBE.

REFERENCES PARTIAL ECONOMIC STUDY OF STEAM COOLED HEAVY WATER MODERATED REACTORS,
AECL, NUCLEAR ENG. BRANCH
AECL-1018 /APRIL 1963/

AFTER CANDU=FOG COOLED REACTORS,
GA PON
CANADIAN CHEM. PROCESSING 45, 83, 92-4
/OCTOBER 1961/

PROSPECTIVE HEAVY WATER-MODERATED POWER REACTORS,
GA PON, OTHERS
3RD U.N. INTL. CONF. PEACEFUL USES OF ATOMIC ENERGY, GENEVA, 1964, A/CONF. 28/P/10

LIGHT WATER COOLED HEAVY WATER MODERATED NATURAL

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. FOREIGN

IF02

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URANIUM POWER REACTORS.

GA PON

AECL-1807 /P. 59-67/ /1963/

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BNWL-326

STEAM OR SUPERCRIT. WATER COOLED REACTORS. FOREIGN

IF03

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NAME/OWNER CAN-ITALY
EURATOM-US PROGRAM INVOLVING CISE /ITALY/, NDA

DESIGNER ANSALDO /ITALY/, NDA

TYPE STEAM COOLED, HEAVY WATER MOD., PRESSURE TUBE

CRITICAL R+D

COOLANT WET STEAM /SPRAY/

MODERATOR HEAVY WATER

FUEL MATERIAL URANIUM-ZIRCONIUM ALLOY

FUEL GEOMETRY HOLLOW RODS

FUEL CLADDING ZIRCALOY-2

FUEL ENRICH. NATURAL

FUEL ASSEMBLY CLUSTER AND CONCENTRIC ELEMENTS STUDIED.
PREFERRED ELEMENT CONSISTS OF TWO CONCENTRIC
ANNULI OF ZIRCALOY-2 CANNED FUEL WITH THREE
ANNULAR COOLANT FLOW CHANNELS AND A SOLID CENTRAL
ZIRCALOY ROD.

REMARKS PRELIMINARY DESIGN AND DEVELOPMENT IN A STUDY
CONTRACT UNDER THE US-EURATOM AGREEMENT. HEAT
TRANSFER, HEAT FLUX, AND CORROSION INVESTIGATIONS
/CAN-1, CAN-2, CAN-3/ HAVE BEEN COMPLETED.
THE CIRENE PROGRAM /CISE REATTOREA NEBBIA/ AIMED
AT THE DESIGN OF A 20 MWE, 100 MWT PROTOTYPE, IS
TO BE COMPLETED IN 1966. SEE IF-4.

REFERENCES CALCULATION METHODS FOR THE CRITICAL SIZE OF A
HEAVY WATER MODERATED, WET STEAM COOLED REACTOR
WITH A NATURAL URANIUM CLUSTER FUEL ELEMENT.
R BONALUME, OTHERS
CISE-67 /1959/
ENERGIA NUCLEARE 7, 192-209 /MARCH 1960/

PRELIMINARY DESIGN STUDIES ON FUEL ELEMENTS FOR A
HEAVY WATER MODERATED, WET STEAM COOLED REACTOR.
I CASAGRANDE, OTHERS
CISE-68 /MAY 1959/

EVALUATION AND INTERPRETATION OF THE EXPERIMENTS
ON ADIABATIC TWO-PHASE FLOW PERFORMED AT CISE
UNDER THE CAN-1 PROGRAM.

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. FOREIGN

IF03

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CISE /ITALY/
EURAE=445 /1962/

ADVANCED RESEARCH PROGRAM ON THE APPLICATION OF
STEAM-WATER SPRAY TO THE COOLING OF LIGHT-WATER
REACTORS /CAN=2/.
CISE /ITALY/
EURAE=475 /1962/

LARGE-SCALE AND IN-PILE TESTING OF LIGHT WATER
STEAM MIXTURES AS REACTOR COOLANTS /CAN=3/.
CISE /ITALY/
EURAE=476 /1962/

THE SPRAY COOLED REACTOR,
JG COLLIER, PMC LACEY
NUCLEAR POWER 5, 68-73 /AUGUST 1960/

CAN=1. FOG COOLANT PROJECT,
M SILVESTRI, OTHERS
NUCLEONICS 19, 86-8 /JANUARY 1961/

THE /CAN/ RESEARCH AND DEVELOPMENT PROGRAM ON THE
APPLICATION OF STEAM-WATER MIXTURES TO THE REACTOR
COOLING.
E VILLANI /CISE/
ENERGIA NUCLEARE /MILAN/ 9, 84-96 /FEBRUARY 1962/

INVESTIGATION OF WET STEAM AS A REACTOR COOLANT
/CAN=2/. VOLUME 2. CONCEPTUAL DESIGN EVALUATION
OF A FOG-COOLED LIGHT WATER REACTOR. FINAL REPORT
M RABER, OTHERS
UNC-5008-2 /AUGUST 10, 1962/

FINAL REPORT COVERING THE PERIOD OCTOBER, 1959 TO
APRIL 30, 1960
NDA-2132-5

SEE ALSO NDA STEAM COOLED REACTOR STUDIES.

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. FOREIGN

IF04

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NAME/OWNER CIRENE /CISE REATTORE A NEBBIA/SORIN, ITALY

DESIGNER SORIN-ITALY

TYPE STEAM COOLED, HEAVY WATER MODERATED, DIRECT CYCLE, PRESSURE TUBE

POWER MWE(MWT) 20

CRITICAL TARGET 1969

COOLANT LIGHT WATER STEAM /BOILING WATER/

MODERATOR HEAVY WATER-COLD, UNPRESSURIZED

FUEL MATERIAL URANIUM DIOXIDE PELLETS OR U METAL TUBES

FUEL GEOMETRY RODS OR TUBES

FUEL CLADDING ZIRCALOY-2

FUEL ENRICH. NATURAL

FUEL ASSEMBLY CLUSTERS WITH URANIUM DIOXIDE RODS OR METAL TUBES ARRANGED IN A CROWN AROUND A GRAPHITE CORE

BURNUP(REFUEL) 1000-1500 MWD/T

REMARKS AN R+D PROGRAM FOR A 20 MWE PROTOTYPE FOG-COOLED REACTOR INCLUDES CONSTRUCTION BY 1969. A PROTOTYPE 100 MWT REACTOR WILL BE DESIGNED UNDER A CNEN-EURATOM-CISE AGREEMENT. CISE WILL REQUEST ENEL AND INDUSTRY SUPPORT FOR PROTOTYPE DESIGN AND CONSTRUCTION. THE CONCEPT CONTEMPLATES DIRECT EXTRACTION AND TRANSFER OF HEAT TO THE TURBO-GENERATOR, ELIMINATING THE NEED FOR HEAT EXCHANGERS.

REFERENCES EURO-NUCLEAR MARCH 1965 P. 114-15
NEWS RELEASE

THE CIRENE PROJECT
A BAHBOUT
EURONUCLEAR 2, 224-28 /MAY 1965/

A NATURAL URANIUM BOILING WATER REACTOR PROJECT,
A BAHBOUT
EURATOM 4, 54-60 /JUNE 1965/

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STEAM OR SUPERCRIT, WATER COOLED REACTORS, FOREIGN

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NUCLEONICS WEEK MARCH 31, 1966 P. 8
NEWS RELEASE

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. FOREIGN 1F05
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NAME/OWNER SCLMR /STEAM COOLED LIGHT WATER MODERATED REACTOR/
MITCHELL, UNITED KINGDOM

DESIGNER MITCHELL=UK

PURPOSE SHIP PROPULSION.

TYPE STEAM COOLED. PRESSURE TUBE. INDIRECT CYCLE.

COOLANT LIGHT WATER STEAM, SUPERHEATED

MODERATOR LIGHT WATER

FUEL MATERIAL URANIUM DIOXIDE HOLLOW PELLETS 0.33 IN. ID./0.54
IN. OD.

FUEL GEOMETRY ROD. ACT. LENGTH 5 FT. /CONCENTRIC TUBES/

FUEL ASSEMBLY 116-ROD CLUSTER, 11X11 /MINUS 4 FOR HOLD-DOWN
BOLTS AND 1 FOR SAMPLING AND THERMOCOUPLE TUBE.
21 ASSEMBLIES/CORE

CONTROL BORON-SS CRUCIFORM RODS

COOLANT TEMP. 850-900 F

COOLANT PRESS. 650 PSIA

REACTOR VESSEL CYLINDRICAL VESSEL CONTAINING MODERATOR AND CORE.

CONTAINMENT VESSEL 21 FT. DIA./30 FT. HIGH.
MODERATOR VESSEL PARTIALLY SUBMERGED IN A WATER
SHIELD TANK AS AN INDIRECT VAPOR-SUPPRESSION
SYSTEM.

REMARKS THE STEAM COOLANT FLOWS UPWARD THROUGH THE OUTER
ANNULUS BETWEEN PRESSURE AND BAFFLE TUBES, BACK
DOWN BETWEEN THE INNER AND OUTER FUEL CANS. OUTER
PRESSURE TUBE OF EACH FUEL ELEMENT, MADE OF
ZIRCONIUM, FORMS THE BOUNDARY BETWEEN THE
PRIMARY STEAM COOLANT AND THE MODERATOR, WHICH
FILLS THE SPACES BETWEEN THE FUEL RODS. THE HIGH
TEMPERATURE STEAM OUTLET PLENUM CHAMBER IS BENEATH
THE CORE. THE UK CONSIDERED THE CONCEPT IN ITS
NUCLEAR SHIP PROGRAM.

REFERENCES MITCHELL'S SCLMR-DESIGN OF COMPETITIVE MARINE
REACTOR.

HJ COLES

NUCLEAR ENG. 8, 58-63 /FEBRUARY 1963/

JANUARY 1967

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STEAM OR SUPERCRIT. WATER COOLED REACTORS. FOREIGN

IF05

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NUCLEAR PROPULSION BY MITCHELL-FAIRFIELD.
NEW MARINE SYSTEM OF LONG LIFE, LOW WEIGHT.
G JACKSON
IMPULSE NO. 24. 6-11 /1964/

JANUARY 1967

BNWL#326

STEAM OR SUPERCRIT. WATER COOLED REACTORS. FOREIGN

IF06

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NAME/OWNER STEAM COOLED FAST REACTOR/W, GERMANY

DESIGNER AEG, MAN, AND BELGIAN FIRMS

PURPOSE PROTOTYPE, FAST BREEDER PROGRAM

TYPE STEAM COOLED FAST BREEDER

POWER MWE(MWT) 300

CRITICAL CONSTRUCTION 1968
TARGET 1973REMARKS A 1000 MWE VERSION IS PLANNED
AEG HAS DECIDED TO BUILD A 25 MW HOT STEAM
REACTOR FOR RESEARCH IN THE TRANSITION FROM
HOT WATER REACTORS, AT GROSSWELZHEIM RESEARCH
CENTER NEAR KAHL. THE REACTOR WILL EVENTUALLY
BE SUPPLIED TO THE DETTINGEN COAL-POWERED
RWE STATION.REFERENCES NUCLEONICS WEEK FEB, 3, 1966 P. 7-8
NEWS RELEASEAPPLIED ATOMICS MARCH 23, 1966 P. 1
NEWS RELEASE

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, FOREIGN

IF07

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NAME/OWNER	SWISS SCHWR/FED. INST. REACTOR RESEARCH, SWITZ.	
DESIGNER	SWISS FED. INST. REACTOR RESEARCH /EIR/	
PURPOSE	POWER	
TYPE	STEAM COOLED, SUPERHEAT, DIRECT CYCLE HORIZONTAL PRESSURE-TUBE	
POWER MWE(MWT)	250	723.7
CRITICAL	DESIGN STUDY, PROPOSED FOR CONSTRUCTION	
COOLANT	LIGHT WATER STEAM	
MODERATOR	HEAVY WATER	
FUEL MATERIAL	URANIUM DIOXIDE PELLETS 13.6 MM. DIA.	
FUEL GEOMETRY	ROD, ACT. LENGTH 660 MM.	
FUEL CLADDING	ZIRCONIUM ALLOY 0.8 MM. THICK, RIBBED	
FUEL ENRICH.	0.99 PER CENT U-235	
FUEL ASSEMBLY	18-ROD BUNDLE, RODS ARRANGED IN TWO CIRCLES WITH SPIDERS AND SPACERS. 6 ELEMENTS/CHANNEL 552 COOLANT CHANNELS, ZIRCONIUM-NIOBIUM PRESSURE TUBES, INTERNAL INSULATION.	
FUEL CHARGE	50.5 TONS URANIUM	
BURNUP(REFUEL)	12,930 MWD/TU	ON-LOAD 5 ELEMENTS/DAY
NEUTRON FLUX	THERMAL MAX. 6.7×10^{13}	
CONTROL	RODS CHEMICAL SHIM	
COOLANT TEMP.	INLET 324.3 C	OUTLET 393.8 C
COOLANT PRESS.	INLET 112 BARS	
CONTAINMENT	CYLINDRICAL BUILDING CONTAINING REACTOR, COLLECTORS, BOILERS AND BLOWERS, REFUELING EQUIPMENT AND FUEL STORAGE POOLS	
REMARKS	VERTICAL AND HORIZONTAL DESIGNS.	

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STEAM OR SUPERCRIT. WATER COOLED REACTORS, FOREIGN

IF07

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A LOEFFLER-TYPE CYCLE IS ADOPTED, WITH WATER
EVAPORATED IN AN EXTERNAL HEAT EXCHANGER.
THE REACTOR ACTS AS A SUPERHEATER, DELIVERING
STEAM BOTH TO THE EVAPORATORS AND TO THE TURBINES.

REFERENCES

DESIGN OF A STEAM COOLED NUCLEAR POWER PLANT,
EIR, SWITZERLAND
NT /NEUE TECHNIK/ FEB. 1966 P. 1-10

NUCLEAR AUXILIARY POWER SYSTEMS
SNAP-TYPE REACTORS

DOMESTIC

JANUARY 1967

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC * * * * * J001

NAME/OWNER AEC-S PROGRAM

TYPE SNAP SYSTEMS PROGRAM, AEC.

REMARKS

AEC-S SNAP PROGRAM IS AIMED AT THE DEVELOPMENT OF COMPACT, LIGHTWEIGHT NUCLEAR ELECTRIC DEVICES FOR SPACE, SEA AND LAND APPLICATIONS. COMPACT POWER PACKAGES BASED ON THE CONVERSION OF FISSION OR RADIOACTIVE DECAY HEAT, OR ON REACTOR SYSTEMS, ARE UNDER DEVELOPMENT FOR USE IN SATELLITES AND SPACE VEHICLES. TO POWER REMOTE SCIENTIFIC STATIONS AND NAVIGATION DEVICES. SYSTEMS BASED ON THE CONVERSION OF HEAT FROM RADIOACTIVE SOURCES ARE ODD-NUMBERED. SYSTEMS EMPLOYING NUCLEAR REACTORS ARE EVEN-NUMBERED. REACTOR SYSTEMS UNDER DEVELOPMENT BY ATOMICS INTERNATIONAL ARE BASED ON HOMOGENEOUS FUEL-MODERATOR ELEMENTS. LIQUID METAL COOLANTS, WITH THE SYSTEM COUPLED TO A MERCURY VAPOR TURBINE GENERATOR.

SNAPE-1, A CERIUM-144 FUELED SPACE POWER UNIT, WAS ASSIGNED TO MARTIN FOR DEVELOPMENT IN 1956, WITH DELIVERY OF THE FIRST COMPLETE UNIT SCHEDULED FOR SEPTEMBER 1959. THIS PROGRAM WAS SUBSEQUENTLY DISCONTINUED. UNDER THE BASIC MARTIN CONTRACT THE SNAPE-3 PROGRAM WAS SUBCONTRACTED FOR THE DEVELOPMENT OF ADVANCED THERMOELECTRIC AND THERMIONIC HEAT-TO-ELECTRICITY CONVERSION SYSTEMS USING RADIOACTIVE HEAT SOURCES. MINNESOTA MINING AND MANUFACTURING DELIVERED A COMPLETE THERMOELECTRIC GENERATOR TO MARTIN IN DECEMBER 1958, AND POLONIUM-210 FUEL CAPSULES WERE FURNISHED BY AEC-S MOUND LABORATORY. THE ASSEMBLED AND TESTED UNIT WAS DELIVERED TO THE AEC IN JANUARY 1959. AS A PROOF-OF-PRINCIPLE DEMONSTRATION DEVICE, IT PRODUCED 205 WATTS WITH A HALF CHARGE OF POLONIUM-210 FUEL.

REFERENCES

ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK, VOLUME XI, RADIOISOTOPE SYSTEM DESIGN, FINAL REPORT 390.
ELECTRO-OPTICAL SYSTEMS INC. /PASADENA, CALIF./
WADD-TR-60-699, VOL. XI /SEPTEMBER 1960/

THE SNAP PROGRAM: U.S. AEC-S SPACE-ELECTRIC POWER PROGRAM;
GM ANDERSON
NUCLEAR ENG. 5, 460-3 /OCTOBER 1960/

SNAPE THERMOELECTRIC SYSTEMS.
AM THIELE, MG COOMBS

JANUARY 1967

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD01

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ARS SPACE POWER SYSTEM CONFERENCE, SANTA MONICA,
CALIFORNIA, SEPTEMBER 27-30, 1960
PAPER 1330-60
AMERICAN ROCKET SOC., N.Y. /1960/

NUCLEAR FRONTIERS - 1960
A FORUM REPORT /NO. 32/
PROC. ANNUAL CONF. FOR MEMBERS AND GUESTS,
SAN FRANCISCO, CALIFORNIA, DECEMBER 14-16, 1960
EA WIGGIN, ED.
ATOMIC INDUSTRIAL FORUM, N.Y. /1961/

SNAP FACT SHEET.
AEC NEWS RELEASE, JUNE 15, 1962

JANUARY 1967

BNWL-326

NUCLEAR AUXILIARY POWER SYSTEMS: DOMESTIC

J002

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NAME/OWNER	SNAP-2/AEC-AIR FORCE		
DESIGNER	ATOMICS INTERNATIONAL		
PURPOSE	SPACE AUXILIARY POWER		
TYPE	REACTOR SYSTEM, AUXILIARY POWER, LIQ. METAL COOLED THERMOELECTRIC CONVERSION		
POWER MWE(MWT)	3 KW	55 KW	
CRITICAL	DESIGN, DEVELOPMENT		
COOLANT	SODIUM-POTASSIUM NAK		
MODERATOR	HYDROGEN IN FUEL-MODERATOR ELEMENTS		
FUEL MATERIAL	URANIUM-ZIRCONIUM HYDRIDE		
FUEL GEOMETRY	RODS 1.25 IN. DIA.		
FUEL CLADDING	SS		
FUEL ENRICH.	93 PER CENT U-235		
FUEL ASSEMBLY	37 RODS/CORE		
SPECIFIC POWER	0.03 PER CENT		
BURNUP(REFUEL)	LIFETIME 1 YEAR		
NEUTRON FLUX	3.1×10^{11}		
CONTROL	DRUMS		
COOLANT TEMP.	INLET 1000F	OUTLET 1200 F	
CONTAINMENT	STAINLESS STEEL		
REMARKS	POWER CONVERSION EQUIPMENT IS A MERCURY-RANKINE COMBINED ROTATING UNIT. SNAP-2 AS A SYSTEM HAS BEEN TERMINATED, BUT IS CONTINUING AS A BASIC RESEARCH PROGRAM ON ZIRCONIUM HYDRIDE REACTOR SYSTEMS.		
REFERENCES	THE SNAP-2 CONCEPT, HM DIECKAMP ARS SPACE POWER SYSTEMS CONFERENCE, SANTA MONICA, CALIFORNIA, SEPTEMBER 27-30, 1960 PAPER NO. 1324-60		

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JD02

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AMERICAN ROCKET SOC., N.Y. /1960/

AN ENRICHED UO₂-ZRH CRITICAL ASSEMBLY,
MV DAVIS, OTHERS
NAA-SR-5610 /NOVEMBER 1960/

SNAP-2, NUCLEAR SPACE POWER SYSTEM.
JR WETCH, HM DIECKAMP, DJ COCKERAM /AI/
ASTRONAUTICS 5 /12/, 24-5 /DECEMBER 1960/

PRELIMINARY RESULTS ON THE SNAP-2 EXPERIMENTAL
REACTOR.
MW HULIN, J BEALL, ED.
NAA-SR-5991 /APRIL 1961/

SNAP-2 POWER CONVERSION STUDIES.
DL SOUTHAM
SPACE POWER SYSTEMS, P. 291
NW SNYDER, ED.
ACADEMIC PRESS, N.Y.

SYSTEMS ANALYSIS OF NUCLEAR /SNAP-2/ LIQUID METAL
CELL SPACE POWER SYSTEM.
GENERAL MOTORS CORP.
EDR-3113 /DEC. 5, 1962/

NUCLEAR REACTOR SYSTEMS
GM ANDERSON /US AEC/
ASTRONAUTICS/AEROSPACE ENG. 1 /4/, 27-36 MAY 1963

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD03

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NAME/OWNER	SNAP-4/AEC-NAVY		
DESIGNER	ATOMICS INTERNATIONAL		
PURPOSE	UNATTENDED UNDERWATER OPERATION		
TYPE	REACTOR SYSTEM, AUXILIARY POWER, BWR, THERMOELECTRIC CONVERSION		
POWER MWE(MWT)	2	12	
CRITICAL	DESIGN, DEVELOPMENT		
COOLANT	LIGHT WATER		
MODERATOR	HYDROGEN IN FUEL-MODERATOR ELEMENTS		
FUEL MATERIAL	URANIUM-ZIRCONIUM HYDRIDE		
FUEL GEOMETRY	RODS		
FUEL CLADDING	SS		
FUEL ENRICH.	93 PER CENT U-235		
BURNUP(REFUEL)	OPERATING LIFETIME 1-PLUS YEARS		
COOLANT TEMP.	INLET 540 F	OUTLET 570 F	
REMARKS	SNAP-4 IS BEING PHASED OUT AS A SYSTEM BY THE AEC. IN-PILE TESTING OF FUEL SAMPLES WILL BE FOLLOWED THROUGH. AI WILL APPLY ACQUIRED TECHNOLOGY TO ITS COMPACT /COMPACT MULTI-PURPOSE AUTOMATIC CONTROLLED TRANSPORTABLE/ REACTOR EFFORT.		
REFERENCES	SNAP FACT SHEET, USAEC, NEWS RELEASE, JUNE 1962 HEARING BEFORE THE U.S. JOINT COMMITTEE ON ATOMIC ENERGY. CONGRESS OF THE UNITED STATES, 87TH CONGRESS, SECOND SECTION ON PEACEFUL USES OF ATOMIC ENERGY APRIL 10, 1962 /P. 140-143/		

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD04

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NAME/OWNER SNAP-8/AEC-NASA

DESIGNER ATOMICS INTERNATIONAL

LOCATION S8ER AT SANTA SUSANA, CALIF.

PURPOSE SPACE POWER

TYPE REACTOR SYSTEM, AUXILIARY POWER, LIQ. METAL COOLED
THERMOELECTRIC CONVERSION

POWER MWE(MWT) 35 KWE 450-600 KWT

CRITICAL S8ER DEC. 1963

COOLANT SODIUM-POTASSIUM NAK

MODERATOR ZIRCONIUM HYDRIDE
 BERYLLIUM REFLECTOR

FUEL MATERIAL URANIUM-ZIRCONIUM HYDRIDE

FUEL GEOMETRY ROD 0.56 2N. DIA./14.5 IN. LONG

FUEL CLADDING HASTELLOY, 0.010 IN. THICK

FUEL ENRICH. FULL

FUEL ASSEMBLY BUNDLE
 211 ELEMENTS/CORE /S8ER/

FUEL CHARGE 6.56 KG. U-235

BURNUP(REFUEL) 10,000 HOUR OPERATING LIFE

NEUTRON FLUX THERMAL AVE. 5×10^{12}

CONTROL 6 REFLECTOR CONTROL DRUMS

COOLANT TEMP. INLET 1100 F OUTLET 1300 F

COOLANT PRESS. 40 PSIA

REACTOR VESSEL 9.75 IN. DIA./21 IN. HIGH VESSEL, SS

CONTAINMENT SHIELDING

REMARKS HIGH POWER, HIGH TEMPERATURE REACTOR DEVELOPMENT,
MERCURY RANKINE CYCLE POWER CONVERSION SYSTEM. AS
OF APRIL 3, 1964. THE S8ER /SNAP-8 EXPERIMENTAL

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JD04

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REACTOR/ PRODUCED AN INTEGRAL POWER OUTPUT OF OVER
1,000,000KWH/T/ DURING 48 DAYS OF OPERATION.
SNAP-8 WILL BE CANCELED AS A PROJECT IN 1964-5.
CONVERSION EQUIPMENT TESTING WILL BE STRETCHED OUT
BY NASA, AND THE AEC WILL BUILD AN EXPERIMENTAL
REACTOR WITH FLIGHT-TYPE COMPONENTS.
A SNAP-8 IS BEING FABRICATED FOR NUCLEAR TESTING

REFERENCES

NUCLEAR POWER AND SPACE.
GT SEABORG
IRE TRANS. NUCLEAR SCI. NS-9, 1-8 /JANUARY 1962/

SNAP-8 REACTOR AND SHIELD
CE JOHNSON, CA GOETZ
AIAA J. 1 /10/, 2355-9 /OCT. 1963/

NUCLEAR REACTOR SYSTEMS
GM ANDERSON /US AEC/
ASTRONAUTICS/AERSOPACE ENG. 1 /4/, 27-36 MAY 1963

SNAP-8 REACTOR AND SHIELD DESIGNS AND OPERATING
EXPERIENCE.
CE JOHNSON, DG MASON
J. SPACECRAFT AND ROCKETS 3, 1099-1105 /JULY 1966

JANUARY 1967

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD05

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NAME/OWNER SNAP-10A/AEC-NASA

DESIGNER ATOMICS INTERNATIONAL

LOCATION SPACE

PURPOSE SPACE AUXILIARY POWER

TYPE REACTOR SYSTEM, AUXILIARY POWER, LIQ. METAL COOLED
THERMOELECTRIC CONVERSION

POWER MWE(MWT) 500 WATTS 35 KWT

CRITICAL ORBITAL LAUNCH IN APRIL 1965

COOLANT SODIUM-POTASSIUM NAK

MODERATOR HYDROGEN IN FUEL-MODERATOR ELEMENTS, BERYLLIUM
REFLECTOR,

FUEL MATERIAL URANIUM-ZIRCONIUM HYDRIDE

FUEL GEOMETRY ROD 1.25 IN. DIA./13 IN. LONG

FUEL CLADDING SS 0.015 IN. THICK

FUEL ENRICH. FULL

FUEL ASSEMBLY 37 INDIVIDUAL ELEMENTS/CORE IN A
CLOSE-PACKED TRIANGULAR MATRIX

FUEL CHARGE 4.3 KG. U-235

BURNUP(REFUEL) 1-YEAR LIFETIME

NEUTRON FLUX 1.8×10^{11}

CONTROL ROTATING ELEMENTS OF REFLECTOR, RADIAL REGION

COOLANT TEMP. INLET 880 F OUTLET 990 F

REACTOR VESSEL 9 IN. DIA./15.6 IN. LONG VESSEL

CONTAINMENT SHIELDING

REMARKS SNAP-10A IS A TEMPERATURE AND POWER DERATED
VERSION OF THE SNAP-2 CONCEPT, GROUND TESTING OF
THE 500-WATT SYSTEM WAS DONE IN JANUARY 1965, AND
COMPLETE SYSTEM LAUNCHED INTO POLAR ORBIT ON
APRIL 3, 1965, POWER PRODUCTION WAS 600 WATTS

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD06

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NAME/OWNER SNAP-15A/AEC

DESIGNER GENERAL DYNAMICS CORPORATION

PURPOSE AUXILIARY POWER, PROBABLE SPACE APPLICATION.

TYPE ISOTOPE SYSTEM, POWER GENERATOR

POWER MWE(MWT) 4-10 WATTS

FUEL MATERIAL PLUTONIUM-238

REMARKS A CONTRACT WAS AWARDED TO GD BY AEC FOR DESIGN AND DEVELOPMENT. NO MISSION HAS BEEN SELECTED FOR THE SYSTEM, GD IS ALSO DEVELOPING PLUTONIUM-238 FUELED GENERATORS IN THE MILLIWATT RANGE FOR TERRESTRIAL APPLICATION.

REFERENCES NUCLEONICS WEEK MAY 23, 1963
NEWS RELEASE

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD07

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NAME/OWNER PULSING TRIGA/GD

DESIGNER GENERAL DYNAMICS CORPORATION

PURPOSE OCEANOGRAPHIC RESEARCH VESSEL, AUXILIARY POWER

TYPE REACTOR SYSTEM, AUXILIARY POWER BWR OR PWR,
 THERMOELECTRIC CONVERSION

POWER MWE(MWT) 2.5

CRITICAL PROPOSAL

COOLANT LIGHT WATER

MODERATOR HYDROGEN IN FUEL-MODERATOR ELEMENTS

FUEL MATERIAL URANIUM-ZIRCONIUM HYDRIDE

REMARKS GD HAS PROPOSED THE SYSTEM TO THE NAVY AS A
 PORTABLE, SELF-REGULATING PACKAGE PLANT. THE
 EXTRAPOLATION IS BASED ON A 25-50 KWE REACTOR FOR
 POWER REQUIREMENTS FOR AN OCEANOGRAPHIC RESEARCH
 CRAFT, OR FOR SUBMERSIBLE OPERATION.

REFERENCES FORUM MEMO MARCH 1961 P. 10-11
 NEWS RELEASE

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NUCLEAR AUXILIARY POWER SYSTEMS, DOMESTIC

JD08

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NAME/OWNER	THERMIONIC REACTOR/GD
DESIGNER	GENERAL DYNAMICS CORPORATION
PURPOSE	AUXILIARY POWER
TYPE	REACTOR SYSTEM, AUXILIARY POWER THERMIONIC CONVERSION
POWER MWE(MWT)	1 10
CRITICAL	STUDY
COOLANT	LIGHT WATER
FUEL MATERIAL	URANIUM-ZIRCONIUM CARBIDE
FUEL GEOMETRY	CYLINDRICAL RODS
FUEL CLADDING	SS SHROUD
FUEL ENRICH.	FULL
FUEL ASSEMBLY	35 SERIES-CONNECTED THERMIONIC ELEMENTS, CYLINDRICAL FUEL RODS SURROUNDED BY TUNGSTEN EMITTER AND NIOBIUM COLLECTOR, ALUMINA INSULATION
FUEL CHARGE	55 KG U-235
CONTROL	BORON-SS BLADES
REMARKS	DEVELOPMENT, STUDY
REFERENCES	A 1-MWE THERMIONIC REACTOR CONCEPTUAL DESIGN, CW SAVERY, OTHERS /GD/ TRANS. AMERICAN NUCLEAR SOC. 6 /1/, 93 /JUNE 1963/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC J009
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NAME/OWNER	STAR /SPACE THERMIONIC AUXILIARY REACTOR//GE
DESIGNER	GENERAL ELECTRIC COMPANY
PURPOSE	SPACE AUXILIARY POWER
TYPE	REACTOR SYSTEM, THERMIONIC CONVERSION
POWER MWE(MWT)	1 11
CRITICAL	DEVELOPMENT
COOLANT	SODIUM
MODERATOR	NONE REFLECTOR, BERYLLIUM OXIDE
FUEL MATERIAL	URANIUM DIOXIDE INDIVIDUAL RINGS
FUEL CLADDING	TUNGSTEN, MOLYBDENUM, NIOBIUM, OR ALUMINA
FUEL ENRICH.	FULL
FUEL ASSEMBLY	HOLLOW CYCLINDER COMPOSED OF SEGMENTED RINGS, EACH RING CONSISTING OF INDIVIDUAL SEGMENTS OF REACTOR FUEL AND CESIUM-PLASMA CONVERTER.
CONTROL	MOTION OF END CONVERTER.
REMARKS	DEVELOPMENT AT PLEASANTON, CALIF. LABORATORY. AN AIR FORCE CONTRACT FOR A STAR-R THERMIONIC REACTOR UNIT WAS AWARDED. 6-MONTH DESIGN ANALYSIS HAS BEEN COMPLETED. PHASE 2 CONTRACT FOR STAR-C. A DEVELOPMENT OF A 100 KWE - 1 MWE CONDUCTION-COOLED REACTOR. AEC CONTRACT IS FOR IN-PILE TESTING OF CONVERTERS.

REFERENCES
DEVELOPMENT OF NUCLEAR THERMIONIC FUEL ELEMENT.
ANNUAL SUMMARY AND QUARTERLY PROGRESS REPORT
NO. 4, MARCH 1, 1963-MAY 30, 1963
GENERAL ELECTRIC CO., VALLECITOS LAB., PLEASANTON
GESR-2017 /ND/

LARGE TURBO-NUCLEAR SPACE POWER SYSTEMS.
MA ZYSKIN /GENERAL ELECTRIC., PHILA./
P. 201-59 3F ADVANCED PROPULSION CONCEPTS,
VOL. 1 No. 1, GORDON AND BREACH, 1963.

THERMIONIC CONVERTERS FOR SPACE POWER
VC WILSON, RC HAMILTON /GEN. ELEC. CO. RES. LAB./
ASTRONAUTICS/AEROSPACE ENG. 1 /4/ 62-67 MAY 1963

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD10

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NAME/OWNER THERMOELECTRIC GENERATOR/AIR FORCE

DESIGNER GENERAL ELECTRIC COMPANY

LOCATION PROTOTYPE AT GE INSTALLATION

PURPOSE POWER FOR ELECTRONIC EQUIPMENT AND SMALL
 SATELLITES.

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION.

POWER MWE(MWT) 0.5 WATT

CRITICAL PROTOTYPE TESTING 1963

FUEL MATERIAL THULIUM-170

FUEL ASSEMBLY PENCIL-SIZED THERMOCOUPLE MODULES OF
 LEAD TELLURIDE THERMOELECTRIC ELEMENTS, WITH THE
 ENCAPSULATED FUEL IN THE MIDDLE. MODULES ARE
 CONNECTED IN SERIES.

FUEL CHARGE 10,000 Curies THULIUM-170

REMARKS GE HAS DESIGNED, BUILT, AND TESTED A PROTOTYPE
 UNIT. LONG-TERM PERFORMANCE TESTS ARE UNDER WAY.
 OTHER APPLICATIONS WOULD BE FOR UNDERWATER
 NAVIGATIONAL BEACONS AND OTHER REMOTE DEVICES.

REFERENCES FORUM MEMO OCT, 1963 P. 21.
 NEWS RELEASE

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC JD11
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NAME/OWNER	MFP /MIXED FISSION PRODUCTS GENERATOR/AEC
DESIGNER	GENERAL INSTRUMENT CORPORATION
PURPOSE	AUXILIARY POWER, UNDERWATER ENVIRONMENT
TYPE	ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION
POWER MWE(MWT)	5-10 WATTS
CRITICAL	DEVELOPMENT, CONCEPTUAL DESIGN.
FUEL MATERIAL	MIXED FISSION PRODUCTS /POTS FROM CALCINATION PROCESSES/
FUEL GEOMETRY	POT /CYLINDER OR SPHERE/ OF HASTELLOY
FUEL ASSEMBLY	SINGLE POT
BURNUP(REFUEL)	5-YEAR LIFETIME
REACTOR VESSEL	STAINLESS STEEL CYLINDRICAL CONTAINER FOR HEAT TRANSFER FLUID, SURROUNDING THE POT FUEL, AND OUTER PRESSURE VESSEL.
CONTAINMENT	CONCRETE AND IRON SHIELDING.
REMARKS	AN ELECTRICALLY HEATED PROOF-OF-PRINCIPLE 3-5 WATT MFP GENERATOR WAS OPERATED CONTINUOUSLY FOR OVER A YEAR AT 4 PER CENT OVER ALL EFFICIENCY. PROGRAM REORIENTATION WILL DELAY DELIVERY DATE. ORIGINALLY SET FOR EARLY 1964, A FUELED MFP GENERATOR MAY BE ELIMINATED, WITH CONTINUED EXPERIMENTATION TO BE DIRECTED TOWARD GENERATORS WITH HIGHER OUTPUTS. THE GENERATOR WOULD BE FUELED AT AN AEC INSTALLATION. CONCEPTUAL DESIGNS FOR GENERATORS UP TO POWER LEVELS OF 1000 WATTS HAVE BEEN DONE.

REFERENCES

DEVELOPMENT TECHNIQUES FOR POWER PRODUCTION FROM MIXED FISSION PRODUCTS. PHASE 2 MID-TERM REPORT.
EJ LEMANSKI /GENERAL INSTRUMENT CORP./
NYO-9700 /MAY 21, 1962/

ECONOMIC FACTORS OF MFP THERMOELECTRIC GENERATORS.
FINAL REPORT.
EJ LEMANSKI /GENERAL INSTRUMENT CORP./
NYO-10462 /MAY 1963/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD12

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NAME/OWNER SNAP-15B/AEC

DESIGNER GENERAL INSTRUMENT CORPORATION

PURPOSE AUXILIARY POWER, TERRESTRIAL USE.

TYPE ISOTOPE SYSTEM

POWER MWE(MWT) MILLIWATT RANGE

CRITICAL DEVELOPMENT

FUEL MATERIAL PLUTONIUM-238

REMARKS AEC DEVELOPMENT CONTRACT FOR FUELED GENERATORS IN
THE MILLIWATT RANGE.

REFERENCES NEWS RELEASE

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD13

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NAME/OWNER	GLOWWORM/LASL
DESIGNER	LOS ALAMOS SCIENTIFIC LABORATORY
PURPOSE	CONCEPTUAL STUDY, SATELLITE POWER, RESEARCH FACILITY.
TYPE	REACTOR SYSTEM, RADIATION HEAT EXCHANGE CONCEPT.
CRITICAL	CONCEPTUAL DESIGN
COOLANT	LIQUID OR GAS
MODERATOR	GRAPHITE. BERYLLIUM OR GRAPHITE REFLECTOR
FUEL MATERIAL	URANIUM/PLUTONIUM DIOXIDE OR CARBIDE IN GRAPHITE /CERMET/.
FUEL GEOMETRY	CYLINDER OR SLEEVE, FUELED GRAPHITE
FUEL ENRICH.	SLIGHT
FUEL ASSEMBLY	SIMPLE CYLINDRICAL REACTOR, FUELED GRAPHITE SLEEVE 3-REGION REACTOR, TWO ANNULAR FUELED GRAPHITE SLEEVES, INTERMEDIATE AND INNER, WITH HIGHER FUEL CONCENTRATION IN INNER CYLINDER. HOLLOW CORE TUNGSTEN SLEEVES ARE ALSO CONSIDERED.
REMARKS	EXPLORATORY STUDY OF EARLIER CONCEPT, LARRE /LOS ALAMOS RADIATION REACTOR EXPERIMENT/. VERY HIGH FUEL TEMPERATURE IS REQUIRED FOR ENERGY EXTRACTION BY RADIATION. HEAT EXCHANGERS WOULD BE IN THE REFLECTORS, AS TUBES OR HOLES IN THE GRAPHITE THROUGH WHICH COOLANT WOULD CIRCULATE. THE CENTER CAVITY COULD BE A RESEARCH CAVITY OR CONTAIN HEAT EXCHANGE SYSTEM.
REFERENCES	A RADIATION REACTOR CONCEPT /GLOWWORM/ LDP KING LAMS-2427 /NOV. 18, 1963/

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NUCLEAR AUXILIARY POWER SYSTEMS, DOMESTIC

JD14

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NAME/OWNER SNAP-1 AND SNAP-1A/AEC

DESIGNER MARTIN-MARIETTA CORPORATION

PURPOSE DEVELOPMENT

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION.

POWER MWE(MWT) 125 WATTS 6500 WATTS

CRITICAL DEVELOPMENT CONTRACT DROPPED. SEE SNAP-3

FUEL MATERIAL CERIUM-144 OXIDE CERAMIC PELLETS

FUEL GEOMETRY CAPSULES

FUEL CLADDING TANTALUM CAPSULES

FUEL ASSEMBLY 7 CAPSULES/GENERATOR, IN CHANNELS DRILLED IN AN
INCONEL CYLINDER.

FUEL CHARGE 0.88 MEGACURIES CERIUM-144

BURNUP(REFUEL) 1-YEAR LIFETIME

REACTOR VESSEL INCONEL-X CYLINDER /SOLID/ WITH CHANNELS FOR FUEL.

CONTAINMENT BIOLOGICAL SHIELD OF MERCURY FILLS INTERNAL VOLUME
OF OUTER SHELL, AND IS DRAINED BEFORE LAUNCH.
OUTER SHELL IS AN ALUMINA-INSULATION-SS SANDWICH,
WITH LEAD TELLURIDE THERMOCOUPLE ELEMENTS INSIDE
THE INSULATION.

REMARKS THE PROGRAM, ASSIGNED TO MARTIN IN 1965, WAS
DISCONTINUED. THE SNAP-3 PROGRAM WAS SUBCONTRACTED
UNDER THE BASIC MARTIN CONTRACT. SNAP-1 DESIGN
USED MERCURY VAPOR AS HEAT CONVERSION WORKING
FLUID. TASK 2 /SNAP-1A/ GENERATORS WERE DESIGNED
FOR 1-YEAR LIFETIME IN A SATELLITE SYSTEM.

REFERENCES SNAP-1 RADIOISOTOPE-FUELED TURBOELECTRIC POWER
CONVERSION SYSTEM SUMMARY, JANUARY 1957 TO
JUNE 1959.
PJ DICK
MND-P-2350 /JUNE 1960/

FINAL SAFETY ANALYSES REPORT. SNAP-1A RADIOISOTOPE
FUELED THERMOELECTRIC GENERATOR.
MARTIN COMPANY /GP DIX/
MND-P-2352 /JUNE 1960/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD15

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NAME/OWNER SNAP-3/AEC-NAVY

DESIGNER MARTIN-MARIETTA CORPORATION

OPERATOR NAVY

LOCATION SPACE

PURPOSE AUXILIARY POWER, SPACECRAFT

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION

POWER MWE(MWT) 2.7 WATT 69 WATT

CRITICAL DEMONSTRATION JANUARY 1959
 TRANSIT OPERATION JUNE 1961

FUEL MATERIAL DEMONSTRATION, POLONIUM-210
 TRANSIT, PLUTONIUM-238

FUEL GEOMETRY CAPSULES

FUEL CLADDING STAINLESS STEEL CAPSULES

FUEL ASSEMBLY 2 CAPSULES CONTAINING FUEL IN A STAINLESS STEEL
 CANISTER.

FUEL CHARGE 2200 CURIES POLONIUM-210
 95 GRAMS PLUTONIUM-238

BURNUP(REFUEL) TRANSIT, 5-YEAR LIFETIME

REACTOR VESSEL HEAVY VESSEL OF HAYNES ALLOY TO HOLD CANISTER.

CONTAINMENT SPHERICAL COPPER SHELL CONTAINING THE GENERATOR,
 THERMOELECTRIC ELEMENTS PLACED AGAINST THE REACTOR
 VESSEL.

REMARKS SNAP-3 SYSTEM DEVELOPMENT WITH PLUTONIUM-238 FUEL
 HAS RESULTED IN GENERATORS FOR THE TRANSIT
 /U.S. NAVY/ SATELLITES. TRANSIT-4B WITH PLUTONIUM-
 238 GENERATOR WAS ORBITED IN NOVEMBER 1961. THE
 FIRST OPERATIONAL TRANSIT-5 IS TO CARRY SNAP-9A
 FUELED WITH PLUTONIUM-238 CARBIDE FUEL FOR AN
 OUTPUT OF 25 WATTS. A CONCEPTUAL DESIGN BASED ON
 CERIUM-144 HAS BEEN COMPLETED.
 MODIFICATIONS TO SNAP-3 UNITS IN NOV. 1961
 INCLUDED FUEL CAPSULE REDESIGN
 A 22-WATT PLUTONIUM-238 SYSTEM /IMP/ WAS
 CONTRACTED FOR IN FEB. 1963. DESIGN IS COMPLETE

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AND PROTOTYPE IN PRODUCTION.

REFERENCES

HAZARDS SUMMARY REPORT FOR A 3-WATT POLONIUM-210
FUELED THERMOELECTRIC GENERATOR.
MARTIN COMPANY
MND-P-2047 /JUNE 1959 DECLASSIFIED SEPTEMBER 1960/

FINAL SAFETY ANALYSIS REPORT. SNAP-3
THERMOELECTRIC GENERATOR.
H HAGIS, GP DIX
MND-P-2364 /JUNE 1960/

CONCEPTUAL DESIGN OF A SNAP-3 TYPE GENERATOR
FUELED WITH CERIUM-144.
RJ WILSON
MND-P-2369 /JUNE 1960/

NUCLEAR SAFETY ANALYSIS OF SNAP-3 FOR SPACE
MISSION.
W HAGIS, OTHERS
ARS J. 31L 1744-51 /DECEMBER 1961/

FROM SNAP-3 TO IMP
JG MORSE, CR FINK
IEEE TRANS. AEROSPACE 2, 642.5 /APRIL 1964/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC JD16
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NAME/OWNER SNAP-7/AEC
 LCG-25

DESIGNER MARTIN-MARIETTA CORPORATION

OPERATOR SEE REMARKS

LOCATION SEE REMARKS

PURPOSE AUXILIARY POWER, TERRESTRIAL APPLICATIONS

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION.

POWER MWE(MWT) 5-60 WATTS. SEE REMARKS.

CRITICAL SEE REMARKS

FUEL MATERIAL STRONTIUM-90 TITANATE

FUEL GEOMETRY CYLINDER

FUEL ASSEMBLY FUEL BLOCK IN HASTELLOY CYLINDRICAL CONTAINER.

FUEL CHARGE SEE REMARKS

REACTOR VESSEL FUEL BLOCK, HASTELLOY

CONTAINMENT DOUBLE-WALLED HASTELLOY VESSEL, DEPLETED URANIUM
SHIELD WITHIN THE WALLS.

REMARKS SNAP-7 INSTALLED AT UNMANNED WEATHER STATION ON
AXEL HEIBERG ISLAND IN THE ARCTIC, SEPT. 1961
5 WATTS, 41,000 CURIES STRONTIUM-90.

SNAP-7A INSTALLED IN FLOATING NAVIGATIONAL BUOY
/COAST GUARD/ IN DEC. 1961 AT ARUNDEL COVE, MD.
5 WATTS, 41,000 CURIES STRONTIUM-90. 2 YEARS
LIFETIME.

SNAP-7B TRANSFERRED FROM CHESAPEAKE BAY NAVIGATION
LIGHT TO OFF-SHORE DRILLING BARGE IN GULF OF
MEXICO, 30 WATTS, 41,000 CURIES STRONTIUM-90.

SNAP-7C INSTALLED AT REMOTE ANTARCTIC WEATHER
STATION NEAR LITTLE AMERICA IN FEB. 1962 /NAVY/.
5 WATTS, 41,000 CURIES STRONTIUM-90. 2 YEAR
LIFETIME.

SNAP-7D INSTALLED ON BARGE-MOUNTED WEATHER STATION
IN THE GULF OF MEXICO /NAVY/ IN MID. 1963.

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JD16

30 WATTS. 225,000 CURIES STRONTIUM-90. 2 YEARS LIFETIME.

SNAP-7E. AN 8-WATT GENERATOR. IN OPERATION IN JULY 1964 AS POWER SOURCE FOR NAVIGATIONAL AIDS. OFF JACKSONVILLE, FLORIDA /NAVY/. 2 YEARS LIFETIME. 31,000 CURIES STRONTIUM-90. DEEP-SEA MISSION-SONAR BEACON.

SNAP-7F WAS PLACED ON AN OIL RIG IN THE GULF OF MEXICO FOR TRIAL USE IN 1964. 60 WATTS.

MARTIN WILL OFFER A COMMERCIAL GENERATOR PATTERNED ON THE SNAP-7 SERIES. THE LCG-25 LOW COST GENERATOR WILL BE A 25-WATT STRONTIUM-90 FUELED THERMOELECTRIC PACKAGE. WITH THE THERMOELECTRIC GENERATOR MOVED OUTSIDE THE RADIATION SHIELD. LATER VERSIONS MAY REACH 40-WATTS. THE NAVAL ELECTRONICS LAB. HAS BOUGHT A 25-WATT MODEL AND INSTALLED IT ON AN ISLAND IN BERING STRAIT OFF ALASKA TO POWER AN OCEANOGRAPHIC MEASURING STATION.

REFERENCES

HAZARDS SUMMARY REPORT FOR A 2-WATT STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR.
MARTIN COMPANY
MND-P-2048 /JUNE 1959 DECLASSIFIED SEPTEMBER 1960/

STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR POWER SOURCE-5-WATT U.S. NAVY WEATHER STATION. FINAL REPORT.
MARTIN COMPANY, NUCLEAR DIV.
MND-P-2707 /ND/

7A. STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR FOR 5-WATT U.S. COAST GUARD LIGHT BUOY. FINAL REPORT.
MARTIN COMPANY
MND-P-2720 /FEBRUARY 1962/

7C. FINAL SAFETY ANALYSIS. 10-WATT STRONTIUM-90 FUELED GENERATOR FOR AN UNATTENDED METEOROLOGICAL STATION.
SNAP-7C.
MARTIN COMPANY
MND-P-2614 /FEBRUARY 1962/

7D. SNAP STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR POWER SOURCE 30-WATT U.S. NAVY FLOATING WEATHER STATION. FINAL REPORT.

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MARTIN COMPANY, NUCLEAR DIV.
MND-P-2835 /MARCH 15, 1963/

7E, FINAL SAFETY EVALUATION OF A 10-WATT
STRONTIUM-90 FUELED GENERATOR FOR A DEEP SEA
APPLICATION-SNAP-7E.
HN BERKOW, VG KELLY
MND-P-2761 /1962/

NUCLEONICS WEEK JAN. 20, 1966 P. 6
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NUCLEONICS WEEK AUG. 18, 1966 P. 6
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NAME/OWNER SNAP-9A/AEC-NAVY

DESIGNER MARTIN-MARIETTA CORPORATION

LOCATION SPACE

PURPOSE AUXILIARY POWER, SPACE SYSTEMS.

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION.

POWER MWE(MWT) 20 WATTS

CRITICAL TRANSIT LAUNCH SEPT. 1963

FUEL MATERIAL PLUTONIUM-238 CARBIDE

FUEL GEOMETRY CAPSULE

FUEL CLADDING STAINLESS STEEL CAPSULE

FUEL ASSEMBLY FUEL CAPSULES IN CANISTER

BURNUP(REFUEL) 5-YEAR LIFETIME

REMARKS THE NAVY NAVIGATIONAL SATELLITE WITH SNAP-9A
INSTALLED FAILED TO ACHIEVE ORBIT ON APRIL, 1964
LAUNCH. AEC REPORTED ALL FUEL BURNED UP COMPLETELY
EARLIER LAUNCHES IN SEPTEMBER AND DECEMBER
/TRANSIT/ WERE SUCCESSFUL AND THE GENERATORS ARE
PROVIDING DESIGN POWER. PROJECTS IMP, NIMBUS, AND
SURVEYOR WILL USE ADVANCED GENERATORS FOR HIGHER
PERFORMANCE. SEE SNAP-19.

REFERENCES SNAPS 9A AND 19A STATUS REPORT.
JG MORSE, CR FINK
MEETING MAY 18-19, 1964.

FROM SNAP-3 TO IMP
JG MORSE, CR FINK
IEEE TRANS. AEROSPACE 2, 642-5 /APRIL 1964/

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NAME/OWNER SNAP-19/AEC-NASA

DESIGNER MARTIN-MARIETTA CORPORATION

OPERATOR NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PURPOSE AUXILIARY POWER

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION.

POWER MWE(MWT) 15 WATTS

CRITICAL TARGET 1965

FUEL MATERIAL PLUTONIUM-238

BURNUP(REFUEL) 5-YEAR LIFETIME

REMARKS SNAP-19 IS A MULTI-PURPOSE FOLLOW-ON OF SNAP-9A.
TWO 15 WATT GENERATORS WILL BE TAILORED TO
NIMBUS-B REQUIREMENTS. THE GENERATORS, MOUNTED IN
TANDEM, WILL FURNISH 30 WATTS OF POWER TO THE
SATELLITE. A FUELED PROTOTYPE WILL BE DELIVERED TO
NASA EARLY IN 1965, AND LATER TWO FUELED UNITS FOR
AN ORBITING NIMBUS.
MARTIN HAS A TOTAL OF 14 FUELED AND UNFUELED
SNAP-19 GENERATORS ON ORDER BY THE AEC. A SYSTEM
CONTAINING TWO SNAP-19 UNITS WILL BE LAUNCHED
WITH NASA-S NIMBUS-B WEATHER SATELLITE IN 1967.

REFERENCES SNAPS-9A AND 19, A STATUS REPORT.

JG MORSE, CR FINK
ATOMIC INDUSTRIAL FORUM. INDUSTRY INFORMATION
MEETING MAY 18-19, 1964

NUCLEAR INDUSTRY OCT. 1965 P. 35
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NAME/OWNER SNAP-11/AEC-NASA

DESIGNER MARTIN-MARIETTA CORPORATION

PURPOSE AUXILIARY POWER, SURVEYOR SPACECRAFT.

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION.

POWER MWE(MWT) 25 WATTS

CRITICAL DESIGN AND DEVELOPMENT

FUEL MATERIAL CURIUM-242, GOLD-CURIUM ALLOY

FUEL GEOMETRY HOLLOW CYLINDER

FUEL CLADDING TANTALUM, THIN INNER AND OUTER LINER.

FUEL ASSEMBLY THIN-WALLED TANTALUM CANISTERS

FUEL CHARGE 6.3 GRAM CURIUM-242 FOR A 755-WATT UNIT.

BURNUP(REFUEL) 6-MONTH MISSION.

CONTAINMENT HASTELLOY OUTER VESSEL, TANTALUM INNER VESSEL, AN
OUTER THIN ALUMINUM CYLINDER DISSIPATES HEAT TO
ENVIRONMENT.

REMARKS SURVEYOR PROJECT FOR SOFT-LANDING OF INSTRUMENTED
PACKAGES ON THE MOON WILL USE CURIUM-242
GENERATORS. ALTERNATE TO SNAP-11 IS SNAP-13.
CURIUM-242 TECHNOLOGY IS BEING APPLIED TO STUDIES
OF CURIUM-244. A THERMAL MOCKUP OF SNAP-11 HAS
BEEN TESTED. PAYLOAD INTEGRATION TESTING UNDER WAY

REFERENCES 100-WATT CURIUM-242 FUELED THERMOELECTRIC
GENERATOR CONCEPTUAL DESIGN. SNAP SUBTASK 5.7
FINAL REPORT.
JB WEDDELL, J BLOOM
MND-P-2342 /MAY 1960/

13-WATT CURIUM-FUELED THERMOELECTRIC GENERATOR FOR
A SIX-MONTH SPACE MISSION. FINAL REPORT,
JL BLOOM
MND-P-2373 /JULY 1960/

SPACE ISOTOPIC POWER SYSTEMS.
RT CARPENTER /USAF/
ASTRONAUTICS AEROSPACE ENG. 1 /4/, 68-72 MAY 1963

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FROM SNAP-3 TO IMP

JG MORSE, CR FINK

IEEE TRANS. AEROSPACE 2, 642-5 /APRIL 1964/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD20

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NAME/OWNER SNAP-13/AEC-NASA

DESIGNER MARTIN-MARIETTA CORPORATION

PURPOSE ALTERNATE TO SNAP-11. DEMONSTRATION UNIT

TYPE ISOTOPE SYSTEM, THERMIONIC CONVERSION,

POWER MWE(MWT) 12.5 WATT

CRITICAL DEMONSTRATION, 1964

FUEL MATERIAL CURIUM-242

FUEL GEOMETRY HOLLOW CYLINDER

BURNUP(REFUEL) 120-DAY LIFE

REMARKS ELECTRICALLY HEATED TEST UNIT AND A FUELED SNAP-13 ARE PROGRAMMED, WITH WORK ON AN IMPROVED UNIT EXTENDED. CURIUM-244 WILL LATER BE USED IN A SIMILAR UNIT. DEMONSTRATION UNIT OPERABLE IN 1964 GE-S PROPOSAL FOR A THERMIONIC SPACE POWER MODULE HAS BEEN SELECTED BY AEC FOR NEGOTIATION OF A 6-MONTH STUDY CONTRACT, AS PHASE-1 OF A 4-PHASE DESIGN EFFORT ON 100-WATT POLONIUM-210 AND CURIUM-244 GENERATORS. SANDIA LAB. WILL PROVIDE TECHNICAL DIRECTION.

REFERENCES SEE SNAP-11

SPACE ISOTOPIC POWER SYSTEMS.
RT CARPENTER /USAF/
ASTRONAUTICS/AEROSPACE ENG. 1 /4/, 68-72 MAY 1963

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD21

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NAME/OWNER	DCR-1 /DIRECT CONVERSION REACTOR//MARTIN
DESIGNER	MARTIN-MARIETTA CORPORATION
PURPOSE	AUXILIARY POWER
TYPE	REACTOR SYSTEM, AUXILIARY POWER, BWR THERMIONIC CONVERSION.
POWER MWE(MWT)	1 16
CRITICAL	DEVELOPMENT
COOLANT	LIGHT WATER
MODERATOR	ZIRCONIUM HYDRIDE
FUEL MATERIAL	URANIUM DIOXIDE-MOLYBDENUM CERMET, PELLETS.
FUEL GEOMETRY	TUBES
FUEL CLADDING	MOLYBDENUM CLADDING ON PELLETS, ZIRCONIUM OXIDE SLEEVE, AND SS TUBE.
FUEL ASSEMBLY	5-ELEMENT CLUSTER
CORE CONSISTS OF 33 FUEL BUNDLES,
CONTAINING 7 FUEL-TUBE CLUSTERS AND
ZIRCONIUM HYDRIDE MODERATOR. THERMIONIC
CONVERTER UNITS ARE INTEGRAL TO THE FUEL
BUNDLE.
REMARKS	REACTOR SYSTEM IS A FORCED CIRCULATION, DIRECT
CYCLE BWR. AN ALTERNATE FUEL SYSTEM CONSIDERED WAS
THE URANIUM DIOXIDE-NIOBIUM SYSTEM. A CONCEPTUAL
LIQUID METAL COOLED SYSTEM USED PHOSPHORUS
SESQUISULFIDE OR NAK AS COOLANT, HOMOGENEOUS
URANIUM-ZIRCONIUM HYDRIDE FUEL-MODERATOR ELEMENTS.
CONVERSION WOULD BE THERMOELECTRIC. ADVANCED
APPROACHES INCLUDE NUCLEAR SUPERHEAT. A
PRELIMINARY DESIGN FOR A 100 KWE REACTOR CORE HAS
BEEN COMPLETED.
REFERENCES	A WATER-COOLED THERMIONIC PORTABLE POWER PLANT.
GL REED
ANS TRANS. 6, 318-19 /NOV 1963/

FEASIBILITY STUDY OF A WATER-COOLED THERMIONIC
NUCLEAR POWER PLANT.
AEROSPACE DIV., MARTIN-MARIETTA CORP.
MND-2903, VOL. 2 /NOV. 1962/ |

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NAME/OWNER TURPS /TERRESTRIAL UNATTENDED REACTOR POWER
SYSTEM/MARTIN

DESIGNER MARTIN-MARIETTA CORPORATION

PURPOSE AUXILIARY POWER, REMOTE SITES OR UNDERSEA

TYPE REACTOR SYSTEM, AUXILIARY POWER, LIQ. METAL COOLED
THERMOELECTRIC CONVERSION.

POWER MWE(MWT) 100KWE 1.56

CRITICAL RESEARCH AND DEVELOPMENT

COOLANT TETRAPHOSPHORUS TRISULFIDE, BOILING
NATURAL CIRCULATION

MODERATOR ZIRCONIUM HYDRIDE

FUEL MATERIAL ZIRCONIUM-URANIUM HYDRIDE

FUEL GEOMETRY TWO-SEGMENT ELEMENT.
FUELED AND UNFUELED ZIRCONIUM HYDRIDE

CONTROL A CONTROL CONCEPT TO BE EVALUATED IS BASED ON THE
MIGRATION OF HYDROGEN IN THE ZIRCONIUM HYDRIDE
UNDER TEMPERATURE CHANGE, AND THE MODERATING
ACTION OF THE HYDROGEN AS IT MIGRATES.

REMARKS A PLANT WOULD CONSIST OF SEVEN 20,000-POUND
PACKAGES. FIRST PACKAGE WOULD BE THE REACTOR,
GENERATOR, AND SHIELD TANK. PHOSPHORUS
SULFIDE AS THE COOLANT WOULD BE BOILED IN
THE REACTOR AND THE VAPOR TRANSPORTED TO THE
THERMOELECTRIC GENERATOR BY NATURAL CIRCULATION.
PLANT FEASIBILITY HAS BEEN DETERMINED.
THE SYSTEM IS BEING SPONSORED BY THE AF SPECIAL
WEAPONS CENTER, KIRTLAND AFB, UNDER A CONTRACT TO
RUN UNTIL JANUARY 1966. AEC AND THE ARMY ARE
EVALUATING THE CONCEPT.
TURPS IS ALSO BEING EVALUATED AS AN
UNDERSEA PLANT
MARTIN HAS RECEIVED A 9-MONTH CONTRACT FROM THE
U. S. ARMY CORPS OF ENGINEERS FOR A FEASIBILITY
STUDY OF THE TURPS CONCEPT FOR A MOBILE NUCLEAR
PLANT.

REFERENCES TETRAPHOSPHORUS TRISULFIDE COOLED THERMOELECTRIC
REACTOR PLANT, CONCEPTUAL DESIGN.
CE MURPHY

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AMERICAN NUCLEAR SOC. TRANS. 6, 320-21 /NOV. 1963/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD23

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NAME/OWNER	UNDERWATER THERMOELECTRIC POWER PLANT/MARTIN
DESIGNER	MARTIN-MARIETTA CORPORATION
PURPOSE	ELECTRICAL POWER FOR UNDERSEA OPERATIONS.
TYPE	REACTOR SYSTEM, AUXILIARY POWER, PWR
THERMOELECTRIC CONVERSION.
POWER MWE(MWT)	100 KWE 2.5
CRITICAL	CONCEPTUAL DESIGN
COOLANT	LIGHT WATER
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE PELLETS
FUEL GEOMETRY	TUBES
FUEL ENRICH.	LOW
FUEL ASSEMBLY	104-TUBE BUNDLE
12 BUNDLES/CORE
CONTROL	BURNABLE POISON, BORON, IN CLADDING.
REACTOR VESSEL	SPHERICAL
CONTAINMENT	THERMAL SHIELD, SEA-WATER SCREEN, AND SEA-WATER
RETAINING SHELL.
REMARKS	CONCEPTUAL DESIGN, A SELF-PRESSURIZED, NATURAL
CIRCULATION REACTOR SYSTEM /PWR/, DESIGNED FOR
REMOTE STARTUP AND COMPLETE UNATTENDED OPERATION.
SYSTEM CONSISTS OF A LOWER PRESSURE VESSEL
CONTAINING THE LOW-ENRICHMENT REACTOR CORE, A
RISER, AN UPPER PLENUM, THREE SEVEN-PLATE
ASSEMBLIES OF THERMOELECTRIC ELEMENTS, AND
INTERCONNECTED PIPING.
REFERENCES	AN 100 KWE UNDERWATER THERMOELECTRIC REACTOR PLANT
CONCEPTUAL DESIGN.
KH DUFRANE
AMERICAN NUCLEAR SOC. TRANS. 6, 319-20 /NOV. 1963/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD24

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NAME/OWNER MPRE /MEDIUM POWER REACTOR EXPERIMENT//AEC
 INTERMEDIATE REACTOR

DESIGNER OAK RIDGE NATIONAL LABORATORY

LOCATION EXPERIMENT AT ORNL

PURPOSE AUXILIARY POWER. INTERMEDIATE BETWEEN SNAP#8 AND
 SNAP#50.

TYPE REACTOR SYSTEM, LIQUID METAL, BOILING,
 DIRECT CYCLE.

POWER MWE(MWT) 125 KWE 1

CRITICAL DEVELOPMENT. EXPERIMENT BEING BUILT.

COOLANT BOILING POTASSIUM

FUEL MATERIAL URANIUM DIOXIDE

REMARKS REACTOR SYSTEM USING BOILING POTASSIUM AS THE HEAT
 TRANSFER FLUID AND DIRECT WORKING FLUID. CORE IS A
 ONE-LOOP SYSTEM, EXPECTED TO OPERATE AT ABOUT
 1500 F. BOILING POTASSIUM COOLANT IS FED TO A
 POTASSIUM TURBINE, THEN TO A RADIATOR, WHERE IT IS
 PUMPED BACK INTO THE CORE.
 TARGET FOR CONSTRUCTION OF MPRE IS 1966 AT ORNL.

REFERENCES BOILING POTASSIUM REACTOR FOR SPACE.
 AP FRAAS
 NUCLEONICS 22, 72-73 /JAN. 1964/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD25

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NAME/OWNER SNAP-50 /SNAP-50/SPUR//AEC-NASA-DOD

DESIGNER PRATT AND WHITNEY AIRCRAFT

PURPOSE AUXILIARY POWER, SPACE

TYPE REACTOR SYSTEM, LIQ. METAL COOLED, FAST.

POWER MWE(MWT) 300-1000 KWE

COOLANT LITHIUM

MODERATOR NONE

FUEL MATERIAL URANIUM/BERYLLIUM OXIDE.
CARBIDE AND NITRIDE STUDIED.

REMARKS SYSTEM CONSISTS OF A HIGH TEMPERATURE COMPACT
REACTOR WITH LITHIUM COOLANT AND POTASSIUM VAPOR
TURBINE. THE LCRE /LITHIUM COOLED REACTOR
EXPERIMENT/ WHICH WAS TO HAVE BEEN BUILT AT AN
IDAHO FACILITY HAS BEEN CANCELED. THE PROGRAM WILL
PROCEED WITH SNAP-50 DESIGN AND DEVELOPMENT.
THE SNAP-50 PROGRAM HAS BEEN REDUCED TO THE LEVEL
OF TECHNOLOGICAL DEVELOPMENT, AND WILL BE MOVED TO
LAWRENCE RADIATION LABORATORY IN CALIFORNIA. THE
PRATT AND WHITNEY OPERATED INSTALLATION /CANEL/
WILL BE CLOSED OUT OVER THE NEXT 6 MONTHS.
LRL WORK WILL BE DIRECTED AT TRYING TO DETERMINE
HOW TO BUILD THE HIGHEST TEMPERATURE REACTOR
SYSTEM THAT COULD BE USED WITH RANKINE CYCLE,
HIGH TEMPERATURE BRAYTON CYCLE, OR OUT-OF-CORE
THERMIONIC SYSTEMS.

REFERENCES SNAP-50/SPUR REACTOR EXPERIMENT.
FD HAINES
TRANS. AMERICAN NUCLEAR SOC. 6 /1/, 88 /JUNE 1963/
/ABSTRACTS/

THE SNAP-50/SPUR NUCLEAR ELECTRIC SPACE POWER
PLANT PROGRAM
EM DOUTHETT, RI STROUGH /PAW/
CONF-650416-1. APRIL 28, 1965

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NAME/OWNER LAMONT GEOPHYSICAL OBSERVATORY GENERATOR

DESIGNER ROYAL RESEARCH CORPORATION

PURPOSE AUXILIARY POWER, DEEP-SEA INSTALLATION.

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION

POWER MWE(MWT) 5 WATT

CRITICAL DESIGN AND DEVELOPMENT

FUEL MATERIAL CESIUM-137 /CESIUM-POLYGLASS/

REMARKS RRC RECEIVED A STUDY CONTRACT FOR A THERMOELECTRIC
GENERATOR BASED ON THE LAMONT GENERATOR DESIGN.

REFERENCES THE CESIUM-137 POWER PROGRAM.
QUARTERLY REPORT NO. 2 /ROYAL RESEARCH CORP./
TID-19333 /JULY 31, 1961/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD27

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NAME/OWNER POODLE/AEC-USAF

DESIGNER TRW SPACE TECHNOLOGY LABS.

PURPOSE ROCKET PROPULSION

TYPE ISOTOPE SYSTEM, LIQUID HYDROGEN PROPELLANT.

POWER MWE(MWT) 10 KW

CRITICAL GROUND TEST 1965

FUEL MATERIAL POLONIUM-210

REMARKS TRW HAS DESIGNED AND PATENTED A NUCLEAR ROCKET, USING HEAT FROM AN ISOTOPIC SOURCE, WHICH WOULD USE LIQUID HYDROGEN AS A PROPELLANT BUT WOULD OPERATE AT LOWER POWER AND THRUST LEVELS THAN THE NUCLEAR ROCKET ROVER. A POODLE STAGE USING A 10 KW SOURCE OPERATING AT TEMPERATURES WITHIN THE LIMITS OF TODAYS ENCAPSULATION TECHNOLOGY WOULD HAVE A SPECIFIC IMPULSE OF UP TO 800 SECONDS AND A THRUST OF 0.5 POUNDS. GROUND TESTS OF POODLE AT MOUND LAB. PRODUCED A SPECIFIC IMPULSE OF 670-700 SEC., EQUAL TO A 2730 F CORE TEMPERATURE. THE NEXT STOP IN THE CONCEPT MAY BE A SNAP-POODLE, USING EXCESS HEAT FROM THE ENERGY SOURCE FOR ELECTRIC POWER IN SPACE UNITS. THE SYSTEM HAS ALSO BEEN PROPOSED FOR DEEP-SPACE PROBES AND MILITARY SATELLITES.

REFERENCES POODLE INTERESTS SATURN OFFICIALS.
WE WILKS
MISSILES AND ROCKETS 14 /23/, 22-3 /JUNE 8, 1964/

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NAME/OWNER	WANL SUBMERGED REACTOR UNIT/WEST
DESIGNER	WESTINGHOUSE ELECTRIC CORP.
ASTRONUCLEAR LAB.
PURPOSE	UNDERSEA POWER, UNATTENDED
TYPE	REACTOR SYSTEM, AUXILIARY POWER, BWR.
THERMOELECTRIC CONVERSION.
POWER MWE(MWT)	3 45
CRITICAL	FEASIBILITY STUDY.
COOLANT	LIGHT WATER
BOILING SULFUR CONSIDERED FOR HIGH TEMPERATURE
SYSTEM.
MODERATOR	LIGHT WATER
FUEL MATERIAL	URANIUM DIOXIDE-NIOBIUM CERMET, URANIUM-BERYLLIUM
OXIDE, OR URANIUM DIOXIDE.
FUEL GEOMETRY	RODS, WITH CONCENTRIC REGIONS OF THERMOELECTRIC
MATERIAL, CONDUCTORS, INSULATION, AND CLADDING.
FUEL ENRICH.	LOW FOR URANIUM DIOXIDE, HIGH FOR CERMET FUELS.
FUEL ASSEMBLY	32-ROD BUNDLE /URANIUM DIOXIDE-NIOBIUM FUEL/
64 BUNDLES/CORE
BURNUP(REFUEL)	2-3 YEAR LIFETIME
REMARKS	FEASIBILITY STUDY HAS BEEN COMPLETED. DESIGN AND
DEVELOPMENT STATUS. THE BWR HAS NATURAL CONVECTION
CIRCULATION.
REFERENCES	PRELIMINARY CORE DESIGN OF A 500 KW/E/
THERMOELECTRIC REACTOR.
R MARKLEY, E SCHWARTZ
WCAP-1737 /MARCH 1961/

FEASIBILITY STUDIES FOR MWE NUCLEAR
THERMOELECTRIC PLANT.
RA CLARK, OTHERS
WANL-PR/A/-002 /DECEMBER 1961/

DIRECT CONVERSION THERMOELECTRIC REACTOR STUDIES.
JC DANKO, OTHERS
PREPRINT PAPER NO. 11. ENGINEERS JOINT COUNCIL. |

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N.Y. 1962.

UNDERSEA REACTOR MAY POWER OCEAN-BOTTOM COMMUNITY,
MACH. DESIGN 34, 28 /DECEMBER 6, 1962/ NEWS ITEM.

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD29

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NAME/OWNER	THERMIONIC CONVERSION REACTOR/MARTIN
DESIGNER	MARTIN-MARIETTA CORPORATION
PURPOSE	AUXILIARY POWER
TYPE	REACTOR SYSTEM, LIQUID METAL COOLED.
THERMIONIC CONVERSION
POWER MWE(MWT)	100 KWE
CRITICAL	DESIGN
COOLANT	SODIUM-POTASSIUM NAK
MODERATOR	YTTRIUM HYDRIDE. BERYLLIA REFLECTOR
FUEL MATERIAL	URANIUM/YTTRIUM HYDRIDE
FUEL CHARGE	145 KG. U-235
REMARKS	PRELIMINARY DESIGN
REFERENCES	PRELIMINARY DESIGN OF A 100 KWE THERMIONIC
CONVERSION REACTOR CORE.
FA RUSSO /MARTIN/
TRANS. AMERICAN NUCLEAR SOC. 7, 378 /NOV. 1964/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD30

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NAME/OWNER SNAP-21/AEC
 DEEP-SEA RADIOISOTOPE THERMOELECTRIC GENERATOR

DESIGNER MINNESOTA MINING/MANUFACTURING CO.
 DEVELOPMENT OF MARTIN CONCEPT

PURPOSE DEEP SEA UNATTENDED POWER SOURCE

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION

POWER MWE(MWT) 10 - 20 WATTS

CRITICAL OPERATIONAL TESTING, TARGET 1967

FUEL MATERIAL STRONTIUM-90

BURNUP(REFUEL) 5-YEAR MINIMUM LIFETIME

REMARKS 3M WILL DEVELOP THE SYSTEM FOR OCEANOGRAPHIC
 RESEARCH AND UNDERWATER NAVIGATIONAL AIDS,
 AND WILL DESIGN AND FABRICATE FOUR 10-WATT AND
 TWO 20-WATT PROTOTYPE MODELS FOR THE AEC.
 PROTOTYPE TESTING IS TO BEGIN IN LATE 1967.
 PHASE 1 PORTION OF THE PROGRAM WAS CONDUCTED BY
 3M AND MARTIN.

REFERENCES A RADIOISOTOPE POWERED UNDERWATER ACOUSTIC BEACON,
 PHASE 1, FINAL REPORT, FEASIBILITY STUDY.
 MARTIN CO.
 MND-3180-1N /JAN. 1965/

DIRECT ENERGY CONVERSION DIGEST JULY 1966
NEWS RELEASE

JANUARY 1967

BNWL-326

NUCLEAR AUXILIARY POWER SYSTEMS, DOMESTIC

JD31

* * * * *

NAME/OWNER SNAP-25/AEC

DESIGNER LOCKHEED MISSILES/SPACE CO., NUMEC

PURPOSE SPACE POWER

TYPE ISOTOPE SYSTEM, CONVERSION BY THERMOCOUPLES

POWER MWE(MWT) 75 WATTS

CRITICAL DEVELOPMENT, FLIGHT TARGET 1967-68
 SEE REMARKS

REMARKS WORK ON SNAP-25 HAS BEEN STOPPED, APPARENTLY
 BECAUSE CONFIGURATION AND POTENTIAL USE OVERLAP
 THE 50-WATT SNAP-27 GENERATOR

REFERENCES NEWS RELEASES

JANUARY 1967

BNWL-326

NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD32

* * * * *

NAME/OWNER SNAP-27/AEC, NASA

DESIGNER GENERAL ELECTRIC CO.
 DEVELOPMENT

OPERATOR NATIONAL AERONAUTICS AND SPACE ADMINISTRATION NASA

PURPOSE POWER FOR INSTRUMENT PACKAGES, APOLLO LUNAR
 LANDING.

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION

POWER MWE(MWT) 50 WATTS

FUEL MATERIAL PLUTONIUM-238

BURNUP(REFUEL) ONE-YEAR MISSION

REMARKS GENERAL ELECTRIC HAS RECEIVED AN AEC DEVELOPMENT
 CONTRACT, FOUR SYSTEMS WILL BE REQUIRED FOR THE
 APOLLO LUNAR-LANDING MISSION. THE 3M COMPANY WILL
 DEVELOP THERMOELECTRIC MODULES.
 ALSEP /APOLLO LUNAR SURFACE EXPERIMENT PACKAGE/

REFERENCES NUCLEAR INDUSTRY OCT. 1965 P. 35
 NEWS RELEASE

JANUARY 1967

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NUCLEAR AUXILIARY POWER SYSTEMS, DOMESTIC

JD33

* * * * *

NAME/OWNER REFLEX/WESTINGHOUSE
 REACTOR FOR LUNAR EXPLORATION

DESIGNER WESTINGHOUSE ELECTRIC CORP.

TYPE LIQUID METAL COOLED, FAST REACTOR

POWER MWE(MWT) POWER, LUNAR BASE AND EXPLORATION MISSIONS

CRITICAL CONCEPTUAL DESIGN

COOLANT POTASSIUM

FUEL MATERIAL URANIUM DIOXIDE

BURNUP(REFUEL) 1-YEAR LIFE

CONTROL TOTALLY AUTOMATIC

COOLANT TEMP. OUTLET 1300 F

CONTAINMENT REACTOR IS TOTALLY SHIELDED

REMARKS POWER CONVERSION SYSTEM IS SIMILAR TO SNAP-8
 THE POTASSIUM COOLANT DRIVES A MERCURY-VAPOR
 TURBINE.

REFERENCES NUCLEAR POWER PLANT=LUNAR EXPLORATION SYSTEM
 FOR APOLLO.
 WESTINGHOUSE ASTRONUCLEAR LAB.
 WANL-PR/S/-009-A /OCT. 1964/

 SPACE APPLICATIONS OF FAST REACTORS.
 DG OTT
 FAST REACTOR TECHNOLOGY, NATIONAL TOPICAL MEETING
 APRIL 26-28, 1965.
 AMERICAN NUCLEAR SOC.
 ANS-100 P.57-64

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD34

* * * * *

NAME/OWNER THERMIONIC CONVERTER PROPULSION SYSTEM/DOUGLAS

DESIGNER DOUGLAS AIRCRAFT

PURPOSE SPACE PROPULSION

TYPE REACTOR SYSTEM, THERMIONIC CONVERSION

POWER MWE(MWT) 5

CRITICAL CONCEPTUAL DESIGN

FUEL MATERIAL URANIUM DIOXIDE-TUNGSTEN CERMET

COOLANT TEMP. 1595 F

REMARKS PROPULSION PLANT INTEGRATED WITH PAYLOAD
REQUIREMENTS FOR MANNED MARS MISSION. LAUNCH
VEHICLE IS AN AUGMENTED SATURN C-5

REFERENCES CONCEPTUAL DESIGN ANALYSIS OF A 5 MWE
THERMIONIC REACTOR SPACE PROPULSION PLANT,
FA ROSS, TF PLUNKETT
NP-14985 /FEB. 1965/

JANUARY 1967

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD35

* * * * *

NAME/OWNER MATTRAC
 MOBILE ARMY THERMAL THERMIONIC REACTOR
 AIR-COOLED

PURPOSE PORTABLE PLANT FOR SPACE OR TERRESTRIAL USES

TYPE REACTOR SYSTEM, THERMIONIC CONVERSION

POWER MWE(MWT) 100 KWE

COOLANT AIR

REMARKS MODULAR DESIGN USING A HEAT PIPE TO TRANSFER HEAT
 FROM THE REACTOR TO THE CONVERTER THROUGH BOILING
 OR CONDENSING OF A WORKING FLUID SUCH AS WATER OR
 LITHIUM. CAPILLARY ACTION RETURNS THE CONDENSATE
 TO THE HEAT SOURCE. NO PUMPS ARE NECESSARY.
 HITTMAN AND RCA ARE PREPARING A PROPOSAL.

REFERENCES NUCLEONICS WEEK MARCH 3, 1966 P. 6
 NEWS RELEASE

JANUARY 1967

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NUCLEAR AUXILIARY POWER SYSTEMS, DOMESTIC

JD36

* * * * *

NAME/OWNER SNAP-29/AEC, DOD/NASA

DESIGNER MARTIN-MARIETTA CORP,

PURPOSE POWER FOR SHORT-LIVED EARTH-ORBITAL AND
LUNAR SURFACE MISSIONS

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION.

POWER MWE(MWT) 400 WATTS

CRITICAL DEVELOPMENT

FUEL MATERIAL POLONIUM-210

BURNUP(REFUEL) LIFETIME 139 DAYS

REFERENCES NUCLEONICS WEEK MARCH 24, 1966 P. 2
NEWS RELEASEDIRECT ENERGY CONVERSION DIGEST MARCH 1966 P. 2
NEWS RELEASE

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

J037

* * * * *

NAME/OWNER	RISE /RADIOISOTOPE SUBMERSIBLE ENGINE/AGN
DESIGNER	AEROJET-GENERAL NUCLEONICS
PURPOSE	UNDERSEA PROPULSION OR POWER FOR
MANNED PLATFORMS.
TYPE	ISOTOPE SYSTEM
POWER MWE(MWT)	70 KW
CRITICAL	CONCEPTUAL DESIGN
COOLANT	WATER-STEAM. SEE REMARKS
FUEL MATERIAL	CERIUM-144 AS CERIUM OXIDE
FUEL GEOMETRY	PINS 1.495 IN. DIA., ACT. LENGTH 7.86 IN.
FUEL CLADDING	HASTELLOY-C 0.050 IN. THICK
FUEL ASSEMBLY	HEXAGONAL CLOSE-PACKED ASSEMBLY
TOTAL 19 PINS
SPECIFIC POWER	1/3 CORE IN 6 MONTHS
COOLANT TEMP.	INLET 141 F OUTLET 567 F
COOLANT PRESS.	INLET 1200 PSIA OUTLET APPROX. 1200 PSIA
REACTOR VESSEL	VESSEL 8-25 IN. OD./14.5 IN. LONG/0.2 IN. THICK
CONTAINMENT	SHIELDING IS NATURAL OR DEPLETED URANIUM.
REMARKS	AGN HAS PROPOSED AN ORGANIC-COOLED RISE TO THE
AEC AS AN UNDERSEA PROPULSION SYSTEM, USING THE
RANKINE CYCLE.
REFERENCES	EVALUATION OF RADIOISOTOPE APPLICATIONS IN
HYDROSPACE. FINAL REPORT.
KE BUCK. OTHERS
AGN-8135 /MARCH 1965/

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NUCLEAR AUXILIARY POWER SYSTEMS. DOMESTIC

JD38

* * * * *

NAME/OWNER SNAP-23/US AEC

DESIGNER WESTINGHOUSE ASTRONUCLEAR LAB.

PURPOSE AUXILIARY POWER FOR NAVIGATION BUOYS, LAND-BASED
MICROWAVE REPEATER STATIONS, REMOTE WEATHER
STATIONSTYPE ISOTOPE SYSTEM
THERMOELECTRIC CONVERSION

POWER MWE(MWT) 25, 60, AND 100 WATT UNITS

CRITICAL DEVELOPMENT, PROTOTYPE TARGET 1969

FUEL MATERIAL STRONTIUM-90

FUEL GEOMETRY CAPSULE

BURNUP(REFUEL) 10-YEAR OPERATING LIFE

REMARKS THREE-M HAS RELINQUISHED ALL WORK ON SNAP-23
EXCEPT CONVERTER DESIGN,
WESTINGHOUSE IS TO DELIVER TWO 25-WATT,
FOUR 60-WATT, AND ONE 100-WATT UNITS BY 1969.REFERENCES NUCLEONICS WEEK NOV. 24, 1966 P. 1
NEWS RELEASE

NUCLEAR AUXILIARY POWER SYSTEMS
SNAP-TYPE REACTORS

FOREIGN

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NUCLEAR AUXILIARY POWER SYSTEMS. FOREIGN

JF01

* * * * *

NAME/OWNER FRENCH AUXILIARY POWER DEVELOPMENT PROGRAM.

DESIGNER CEA, FRANCE

PURPOSE RESEARCH AND DEVELOPMENT

POWER MWE(MWT) 12.5 WATTS

FUEL MATERIAL STRONTIUM TITANATE

REMARKS FRANCE WILL DEVELOP NUCLEAR UNITS SIMILAR TO U.S. SNAP GENERATORS. A PILOT PLANT AT SACLAY WILL SEPARATE CESIUM-137 AND STRONTIUM-90. FISSION REACTORS WILL ALSO BE STUDIED. TWO STRONTIUM-FUELED UNITS ARE BEING DEVELOPED FOR USE IN THE NATIONAL SATELLITE PROGRAM. AN R+D CONTRACT HAS BEEN AWARDED BY THE CENTRE NATIONALE D-ETUDES SPATIALES TO THE ELECTRONICS FIRMS CFS AND SNECMA.

REFERENCES NUCLEONICS WEEK APRIL 14, 1966 P. 8
NEWS RELEASE

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NUCLEAR AUXILIARY POWER SYSTEMS. FOREIGN

JF02

* * * * *

NAME/OWNER RIPPLE/AERE, UNITED KINGDOM
 RADIOACTING ISOTOPE POWERED PULSED LIGHT EQUIP

DESIGNER AERE, UNITED KINGDOM

OPERATOR AERE, UNITED KINGDOM

LOCATION DEMONSTRATION AT HARWELL ATOMIC ENERGY RES,
 ESTAB., U.K.

PURPOSE REMOTE LOCATIONS, UNATTENDED OPERATION,

TYPE ISOTOPE SYSTEM, THERMOELECTRIC CONVERSION.

POWER MWE(MWT) 75 MILLIWATTS 4.4 WATTS

CRITICAL DEMONSTRATION MAY 1965

FUEL MATERIAL STRONTIUM-90 TITANATE PELLETS

FUEL CLADDING THIN SS CAPSULE

FUEL CHARGE 700 CURIES STRONTIUM-90

BURNUP(REFUEL) 28-YEAR HALF-LIFE, 10-YEAR LIFETIME

CONTAINMENT RIPPLE-1, LEAD BIOLOGICAL SHIELD
 RIPPLE-2, TUNGSTEN ALLOY BIOLOGICAL SHIELD

REMARKS BISMUTH TELLURIDE THERMOELECTRIC ELEMENTS IN
 MODULE LOCATED ON ONE END OF CYLINDRICAL ISOTOPE
 CAN.
 RIPPLE-1 HAS BEEN EXHIBITED AT THE LONDON RADIO-
 ELECTRONICS CONFERENCE, AND RIPPLE-2 AT THE ROME
 INTERNATIONAL CONFERENCE ON LIGHTHOUSES AND AIDS
 TO NAVIGATION,

REFERENCES INTERIM REPORT ON THE FIRST BRITISH RADIOACTIVE
 ISOTOPE POWERED THERMOELECTRIC GENERATORS RIPPLE-1
 AND RIPPLE-2.
 PD DUNN, FW YEATS
 AERE-M-1594 /1965/

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NUCLEAR AUXILIARY POWER SYSTEMS, FOREIGN

JF03

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NAME/OWNER	ROMASHKA/USSR
DESIGNER	USSR
LOCATION	KURCHATOV ATOMIC ENERGY INST., MOSCOW, USSR.
PURPOSE	AUXILIARY POWER
TYPE	REACTOR SYSTEM, THERMOELECTRIC CONVERSION
CONDUCTION COOLED, FAST REACTOR
POWER MWE(MWT)	500 WATTS 40 KW
CRITICAL	OPERATION AUG. 1964
COOLANT	COOLING IS BY CONDUCTION.
MODERATOR	GRAPHITE
BERYLLIUM REFLECTOR
FUEL MATERIAL	URANIUM CARBIDE, PIE-SHAPED SEGMENTS
FUEL GEOMETRY	GRAPHITE BOXES OR DISHES LOADED WITH
URANIUM CARBIDE, 20 CM. DIA.
FUEL CLADDING	FUEL IS NOT COATED, NOT BONDED TO BOXES OR DISCS.
FUEL ENRICH.	90 PER CENT U-235
FUEL ASSEMBLY	STACKED-DISH ELEMENTS IN A GRAPHITE LINER, FORMING
A CYLINDER APPROX. 2 IN. HIGH.
11 BOXES OR DISHES/CORE
FUEL CHARGE	49 KG. ENRICHED URANIUM
NEUTRON FLUX	TOTAL, CORE CENTER 1×10^{13}
TOTAL, CORE BOUNDARY 7×10^{12}
CONTROL	BORON-SS NEUTRON ABSORBER, BERYLLIUM ALLOY
NEUTRON REFLECTOR RODS
CONTAINMENT	LEAK-TIGHT VESSEL CONTAINING HELIUM ATMOSPHERE.
COVER IS WATER-COOLED
REMARKS	THERMOELECTRIC CONVERSION IS BY MEANS OF SILICON-
GERMANIUM THERMOCOUPLES CONNECTED TO THE REFLECTOR
IN SERIES AND IN PARALLEL. HEAT DISSIPATION IS BY
COPPER COOLING FINS AT THE COLD JUNCTIONS OF THE
CONVERTERS. OPERATING TEMPERATURES ARE 3452 F IN
THE FUEL AND 1650 F AT THE CONVERTER. REACTOR HAS

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NUCLEAR AUXILIARY POWER SYSTEMS. FOREIGN

JF03

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NO MOVING COOLANT AND NO MOVABLE PARTS. ROMASHKA
REPORTEDLY HAS OPERATED AS A COMPLETE SYSTEM FOR
500 OR MORE HOURS.

REFERENCES

ROMASHKA IN PERSPECTIVE,
SD STRAUSS
NUCLEONICS 22 /12/, 68-70 /DEC. 1964/

HIGH TEMPERATURE DIRECT CONVERSION REACTOR
ROMASHKA,
MD MILLIONSHCHIKOV, OTHERS
3RD. UN INTL. CONF PEACEFUL USES ATOMIC ENERGY,
GENEVA, 1964. A /CONF.28/P/873,

NUCLEAR REACTORS IN THE SOVIET UNION.
REPORT OF RECIPROCAL EXCHANGE TRIP TO USSR BY
US ATOMIC SCIENTISTS, DEC. 11-22, 1964
WASH-1060

HIGH TEMPERATURE REACTOR-CONVERTER ROMASHKA
MD MILLIONSHCHIKOV, OTHERS
SOVIET ATOMIC ENERGY 17, 1071-77 /NOV. 1964/

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NUCLEAR AUXILIARY POWER SYSTEMS. FOREIGN

JF04

* * * * *

NAME/OWNER BETA-1/USSR

DESIGNER USSR

OPERATOR USSR

LOCATION NEAR MOSCOW, REMOTE INSTALLATIONS, USSR.

PURPOSE AUXILIARY POWER, UNATTENDED OPERATION.

TYPE ISOTOPE SYSTEM

CRITICAL 1964

FUEL MATERIAL CERIUM-144

REMARKS AN AUTOMATIC ISOTOPE-POWERED WEATHER STATION
REPORTEDLY HAS COMPLETED A YEARS OPERATION
WITHOUT MAINTENANCE NEAR MOSCOW. MANY OF THE
DEVICES ARE SAID TO BE INSTALLED IN REMOTE
REGIONS.

REFERENCES NEWS RELEASES.

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NUCLEAR AUXILIARY POWER SYSTEMS. FOREIGN

JF05

* * * * *

NAME/OWNER DIRECT CONVERSION REACTOR/W, GERMANY

DESIGNER INTERATOM, W, GERMANY

PURPOSE POWER GENERATION

TYPE REACTOR SYSTEM, THERMIONIC CONVERSION
COMPACT SYSTEM

POWER MWE(MWT) 56.5 KW 565 KW

CRITICAL DESIGN STUDY

COOLANT SODIUM METAL VAPOR

MODERATOR ZIRCONIUM HYDRIDE

FUEL MATERIAL URANIUM/ZIRCONIUM CARBIDE

FUEL CHARGE 20 KG.

BURNUP(REFUEL) 20,000 MWD/T FUEL

COOLANT TEMP, INLET 610 C OUTLET 650 C

REMARKS AN INITIAL DESIGN STUDY WILL BE CARRIED OUT BY INTERATOM UNDER A EURATOM CONTRACT, ENTERED INTO IN JULY 1965. THE SYSTEM CONSISTS OF A METAL HYDRIDE MODERATED REACTOR WITH THERMIONIC CONVERTERS ARRANGED OUTSIDE THE REACTOR CORE. HEAT TRANSFER IS BY METAL VAPOR IN EVAPORATOR TUBES FORMING PART OF A FUEL ELEMENT CELL. THERMAL /TRIKT/ AND FAST /SRIKT/ SYSTEMS WILL BE STUDIED. CONVERTER ELEMENTS ARE CESIUM DIODE.

REFERENCES EURATOM INFORMATION 3 /10/, 941 /1965/
NEWS RELEASE

PAGINATION IS BY THE ALPHA - NUMERIC CODE
ASSIGNED TO EACH REACTOR DESIGN. THE CODE
APPEARS AT THE UPPER RIGHT CORNER OF EACH
PAGE. TABS ARE PROVIDED FOR LOCATING THE
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NUCLEAR POWER PROJECTS SUMMARY

DATE:

January 30, 1970

[illegible]

BWR-2

January 30, 1970

[illegible]

[illegible]

| BATTELLE NORTHWEST
<small>BATTELLE MEMORIAL INSTITUTE PACE NORTHWEST LABORATORY</small>
<small>POST OFFICE BOX 999 RICHLAND WASHINGTON 99352</small> | | NUCLEAR POWER PROJECTS SUMMARY
DOMESTIC | | | | | DATE
January 30, 1970 | | |
|---|--|---|------|------|-------|-------------------------------------|--------------------------|-----------------|--|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD T | REMARKS |
| | | | | NET | GROSS | | | | |
| COOPER NUCLEAR STA.
Brownville, Neb.
(Missouri River) | Consumers Public
Power District,
Iowa L & P | General Electric | BWR | 778 | 801 | 2381 | (c) 1972 | | Construction
permit 1968 |
| EDWIN I. HATCH STA.
Baxley, Ga.
(Altamaha River) | Georgia Power Co.
(Member Southern
Company System) | General Electric
Contract award
Dec. 1967 | BWR | 800 | 813 | 2436 | 1973 | 20,000 | Application
May 1968.
Option on 2nd
reactor. |
| CON-EDISON STA. - 5
David's Island,
New York
(Long Island
Sound) | Consolidated Ed. | General Electric | BWR | 1115 | 1148 | First of proposed 4-reactor station | | 1973 | AEC approval
requested.
Orange and
Rockland Util.
has withdrawn. |
| DUANE ARNOLD STA.
Palo, Iowa
(Cedar River) | Iowa Electric L&P
Central Iowa
Power Coop.
Cornbelt Power
Coop.
Operator: Iowa
Elec. | General Electric
Contract award
Feb. 1968 | BWR | 550 | | | | 1973 | Unit 2 not
optioned to
GE |
| BRUNSWICK STATION
Near Wilmington,
S. Carolina
(Estuary, Cape
Fear River) | Carolina P & L | General Electric | BWR | 800 | | | 1974 | | Application
Aug. 1968.
Both reactors
rescheduled. |
| | | | | 800 | | | 1976 | | |

BWR-DOMESTIC (4)

| BATTELLE NORTHWEST
<small>BATTELLE MEMORIAL INSTITUTE PACIFIC NORTHWEST LABORATORY
 POST OFFICE BOX 999 RICHLAND WASHINGTON 99352</small> | | NUCLEAR POWER PROJECTS SUMMARY
DOMESTIC | | | | | | DATE
January 30, 1970 | |
|---|--|---|------|------|-------|------|-----------|--------------------------|---|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD T | REMARKS |
| | | | | NET | GROSS | | | | |
| FITZPATRICK STATION
(Formerly Easton)
Nine Mile Point,
N. Y.
(Lake Ontario) | Power Authority,
State of N. Y.,
Niagara Mohawk
Power | General Electric
Contract closing
delayed because
of revised power
rating | BWR | 800 | | | 1974 | | Application
Dec. 1968 |
| ENRICO FERMI - 2
Monroe, Michigan
(Laguna Beach) | Detroit Edison | General Electric
Contract award
Aug. 1968 | BWR | 1135 | | | 1974 | | Application
April 1969 |
| SHOREHAM STATION-1
Shoreham (Suffolk
County), N. Y.
(Long Island
Sound) | Long Island
Lighting Co.
LILCO | General Electric | BWR | 800 | 880 | 2436 | 1975 | | Rescheduled;
fossil-fueled
station will
be built to
supply 1972
needs. |
| BURNS HARBOR STA.
Dune Acres, Ind.
(Lake Michigan) | Northern Indiana
Public Service Co. | General Electric | BWR | 800 | | | 1975 | | |
| INDIAN POINT - 4, 5
Cortland, N. Y.
(Hudson River) | Consolidated Ed. | General Electric | BWR | 1115 | | | 1975 | | |
| | | | | 1115 | | | 1977 | | |
| BWR-DOMESTIC (5) | | | | | | | | | |

DOMESTIC

January 30, 1970

[illegible]

BATTELLE **B** **NORTHWEST**
BATTELLE MEMORIAL INSTITUTE PACIFIC, NORTHWEST LABORATORY
POST OFFICE BOX 999 RICHLAND, WASHINGTON 99352

NUCLEAR POWER PROJECTS SUMMARY
DOMESTIC GCR-1

DATE _____

January 30, 1970

| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD T | REMARKS |
|--|--|---|------|-----|-------|-----|-----------|-----------------|---------------------------------------|
| | | | | NET | GROSS | | | | |
| FT. SAINT VRAIN STA.
Platteville,
Colorado | Public Service Co.
of Colorado PSCC
Do | General Dynamics
Contract award
Nov. 1965 -
contract has
been modified. | GCR | 330 | 341 | 873 | (c) 1972 | | Construction
permit Sept.
1968. |

[illegible]

PWR-3

January 30, 1970

[illegible]

January 30, 1970

[illegible]

PWR-5

January 30, 1970

[illegible]

PWR-6

January 30, 1970

[illegible]

DATE
January 30, 1970

[illegible]

BATTLE **NORTHWEST**
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NUCLEAR POWER PROJECTS SUMMARY

PWR-8

DATE _____

January 30, 1970

[illegible]

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DOMESTIC | | | | | | DATE
January 30, 1970 | |
|---|-----------------------------------|---|------|---------|-------|-----|-----------|--------------------------|--|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MW† | OPERATION | BURNUP
MWD T | REMARKS |
| | | | | NET | GROSS | | | | |
| AGUIRRE STATION
Aguirre, Puerto Rico
(Near Ponce) | Puerto Rico Water Resources Auth. | | | 300-500 | | | 1976 | | Bids requested. 2 reactors planned. |
| ROOSEVELT BEACH STA.
Grays Harbor, Washington | Grays Harbor PUD (WPPSS System) | | | | | | | | Site studies. |
| BANKS LAKE STATION
Banks Lake, Wash.
(Near Grand Coulee) | Douglas County PUD | | | 1000 | | | | | Feasibility study; plant combined with pumped storage station. |
| BERWICK STATION
Berwick, Penna.
(Susquehanna R.) | Pennsylvania P&L | Preliminary order to GE with option reduce to 800 MWe units and advance dates | | 2200 | | | | | Has been indefinitely deferred. |
| PONTOOK STATION
Pontook, New Hampshire
(Pisqataqua R.) | Public Service Co. New Hampshire | | | 800 | | | 1974 | | Bid evaluation |
| IOWA STATION
Des Moines River, Iowa | Iowa Utilities | Study by Commonwealth Assoc. | | 500-750 | | | 1975 | | |

PROJ-DOMESTIC (1)

INFORMATION ON THIS CHART IS NOT INCLUDED IN THE SUMMARY

| BATTELLE NORTHWEST
<small>BATTELLE MEMORIAL INSTITUTE PALM HARBOR NORTHWEST LABORATORY
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DOMESTIC PROJ-2 | | | | | | DATE
January 30, 1970 | |
|---|--|---|------|----------|-------|-----|-----------|--------------------------|---|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD T | REMARKS |
| | | | | NET | GROSS | | | | |
| HUNTINGTON BEACH STATION
Huntington Beach, Calif. | Metropolitan Water District of S. California | | | | | | | | Planned for 1970 power and desalination. |
| KANSAS STATION
John Redmond Reservoir | Kansas G & E | | | | | | 1973 | | Evaluation of conventional and nuclear plants |
| POINT CONCEPTION
Santa Barbara County, Calif. | Southern Calif. Edison | | | 1000 | | | 1975 | | Announced |
| YANKEE DIXIE STA.
N. Carolina-Virginia region | Yankee-Dixie Power Co. | | | 1600 | | | 1975 | | Planned two-reactor station. |
| BAYSIDE GENERATING STATION
Bayside, N. J. | Atlantic City Electric | GE BWR has been cancelled | | 500-1065 | | | | | Planned |
| EUGENE WATER AND ELECTRIC BOARD STA.
Oregon | Eugene Water and Electric Board | | | 1000 | | | 1976 | | Site selection and environ. studies |
| <div style="display: flex; justify-content: space-between;"> PROJ-DOMESTIC (2) INFORMATION ON THIS CHART IS NOT INCLUDED IN THE SUMMARY </div> | | | | | | | | | |

NUCLEAR POWER PROJECTS SUMMARY
 DOMESTIC PROJ-3

DATE
 January 30, 1970

| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD T | REMARKS |
|--|---|------------------|------|------|-------|-----|-----------|-----------------|--|
| | | | | NET | GROSS | | | | |
| WARD MANOR STATION
Ward Manor, N. Y.
South of Tivoli | Central Hudson
G & E | | | | | | 1975 | | Planned - may
be deferred. |
| KIKET ISLAND STA.
Kiket Island,
Puget Sound | Seattle City Light
Snohomish County
PUD | | | 1000 | | | | | Proposed for
1980 constr. |
| SAN ONOFRE-2 | Southern Calif.
Edison | | | 1100 | | | 1976 | | Bid evaluation |
| McNARY STATION
Umatilla, Ore.
(Columbia R.) | Port of Umatilla | | | 1000 | | | | | Proposal.
Project would
irrigate with
cooling water
from the
plant. |
| PROJ-DOMESTIC (3) | | | | | | | | | INFORMATION ON THIS CHART IS NOT INCLUDED IN THE SUMMARY |

| BATTELLE NORTHWEST
<small>BATTELLE MEMORIAL INSTITUTE PACIFIC NORTHWEST LABORATORY</small>
<small>POST OFFICE BOX 999 RICHLAND WASHINGTON 99352</small> | | NUCLEAR POWER PROJECTS SUMMARY
FOREIGN | | | | | | DATE
January 30, 1970 | |
|--|--|---|---------------------------------|-------------------|-------|------|-----------|--------------------------|-----------------------|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD T | REMARKS |
| | | | | NET | GROSS | | | | |
| GENTILLY STATION
Pointe aux Roches,
Canada
(St. Lawrence R.) | AECL, Canada
Quebec-Hydro
Quebec-Hydro | AECL, Canada | BWR
D ₂ O
mod. | 250 | | | (c) 1971 | | |
| TARAPUR STATION
Tarapur, India
(Arabian Sea) | Gov't. of India | General Electric | BWR | 380 | | 1320 | 1969 | | |
| | | | | From two reactors | | | | | |
| GARIGLIANO STATION
Garigliano, Italy
(Garigliano R.) | Societa Elettro-
nucleare Nazionale
SENN | General Electric | BWR | 150 | | 500 | 1963 | | Refueled
Dec. 1965 |
| ENEL STATION
Near Cremona,
Italy
(Po River) | ENEL, Italy | General Electric,
Ansaldo Meccanico
Nucleare
Contract award
Dec. 1969 | BWR | 750 | | | 1975 | | |
| TSURUGA STATION
Tsuruga, Japan
(Sea of Japan) | Japan Atomic
Power Co.
Do. | General Electric | BWR | 310 | | | (t) 1970 | | Critical Oct.
1969 |
| FUKUSHIMA STATION
Fukushima, North
Honshu, Japan | Tokyo Electric
Power Co.
Do. | General Electric
Contract award
May 1966 and
Jan. 1968 | BWR | 440 | 460 | | (c) 1970 | | |
				760	784		(c) 1973		
				760	784				
BWR-FOREIGN (1)									

BWR-2

January 30, 1970

[illegible]

[illegible]

[illegible]

NUCLEAR POWER PROJECTS SUMMARY
 FOREIGN

GCR-1

DATE

January 30, 1970

| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD T | REMARKS |
|--|--|--------------------------------------|---------------------------------|---------------------|-------|------|-----------------------|-----------------|---|
| | | | | NET | GROSS | | | | |
| BOHUNICE STATION
A-1, 2, 3
Bohunice, Czech. | Czech. Socialist
Republic
(Skoa Works) | USSR | GCR
D ₂ O
mod. | 150 | | 590 | (c) 1972 | | Delay may be
due to clad.
failures |
| | | | | 300 | | | 1974 | | Construction
1970 |
| | | | | 500 | | | | | Planned |
| NEWBRANDENBERG STA.
Neubrandenberg,
East Germany | German Democratic
Republic | USSR | GCR
D ₂ O
mod. | 70 | | 300 | 1965 | | No recent
information |
| CHINON STATION
Chinon, France
(Loire River) | Electricite de
France EDF
Do | CEA, EDF, France | GCR | 68 | | 300 | 1959 | 3,000 | Limited opn.
after heat
exchanger
problems |
| | | | | 195 | | 785 | 1964 | | |
| | | | | (480)
<u>320</u> | | | (1966)
<u>1968</u> | | |
| BUGEY-1 (EDF-5)
Bugey, near
Lyons, France | EDF-CEA, France
EDF | CEA | GCR | 500 | 540 | 2400 | (c) 1971 | | |
| FESSENHEIM STATION
Fessenheim
(Strasbourg)
France | EDF, France | EDF, CEA, France,
Schneider Group | GCR | 680 | | | 1974 | | |
| | | | | 680 | | | 1974 | | |

FOREIGN

GCR-2

January 30, 1970

[illegible]

[illegible]

| BATTELLE
BATTELLE MEMORIAL INSTITUTE
POST OFFICE BOX 999 RICHLAND, WASHINGTON 99352 | | NORTHWEST
PACIFIC NORTHWEST LABORATORY | | NUCLEAR POWER PROJECTS SUMMARY
FOREIGN | | | | | | DATE
January 30, 1970 | |
|---|--|---|------|---|--------------|-----|-----------|-----------------|---|--------------------------|--|
| REACTOR/LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWT | OPERATION | BURNUP
MWD/T | REMARKS | | |
| | | | | NET | GROSS | | | | | | |
| OLDBURY STATION
Severn Estuary | CEGB, Gt. Britain | The Nuclear Power Group, Gt. Brit. | GCR | 650
From | two reactors | | 1967 | 4,500 | | | |
| WYLFA STATION
Wylfa Head,
N. W. Wales | CEGB, Gt. Britain | Atomic Power Group | GCR | 1180
From | two reactors | | 1969 | | | | |
| HARTLEPOOL STATION
Hartlepool, Eng.
(N. E. Coast) | CEGB, Gt. Britain | Babcock English Electric Nuclear | AGR | 625 | | | 1973 | | Contract Oct. 1968.
Site preparation | | |
| | | | | 625 | | | 1974 | | | | |
| HEYSHAM STATION
Gt. Britain | CEGB, Gt. Britain | | AGR | 1200
From | two reactors | | 1975 | | Construction approved - bids invited. | | |
| LATINA STATION
Burgo Sabotino,
(Latina), Italy | Societa Italiana Meridionale Energia Atomica SIMEA | NPPC, Gt. Britain, Agip Nucleare, Italy | GCR | 200 | | 705 | 1964 | | | | |
| TOKAI STATION
Tokai-Mura, Japan
(Pacific Coast) | Japan Atomic Power Co. JAPCO | GEC-Simon Carves, Gt. Britain | GCR | 166 | | 570 | (1965) | | Maintenance shutdown prolonged due to cooling circuit damage. | | |
| | | | | | | | (d) 1970 | | | | |
| GCR-FOREIGN (4) | | | | | | | | | | | |

DATE
January 30, 1970

[illegible]

[illegible]

| BATTELLE NORTHWEST
<small>BATTELLE MEMORIAL INSTITUTE
 POST OFFICE BOX 999 RICHLAND WASHINGTON 99352</small> | | NUCLEAR POWER PROJECTS SUMMARY
FOREIGN HW-2 | | | | | | DATE
January 30, 1970 | |
|--|--|--|---------------------------|-----|-------|-----|-----------|--------------------------|---|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD T | REMARKS |
| | | | | NET | GROSS | | | | |
| SGHWR (STEAM GEN.
HEAVY WATER REACTOR)
Winfrith Heath,
England | Atomic Energy
Authority, Gt.
Britain UKAEA | UK AEA | D ₂ O | 90 | | 295 | (d) 1970 | | Fuel failures
in Nov. 1968 |
| LAVRION STATION
Lavrion, Greece | Public Power
Corp., Greece | UK AEA | D ₂ O
SGHWR | 450 | | | 1974 | | Protocol
signed - no
recent info. |
| RAPP STATION
(RAJASTHAN ATOMIC
POWER PROJECT
Rana Pratap
Sagar, India
(Reservoir) | Gov't. of India | Canadian General
Electric | D ₂ O | 200 | | | (c) 1970 | | |
| | | | | 200 | | | (c) 1974 | | |
| KALPAKKAM STATION
Kalpakkam, India | Gov't. of India | India Dept. of
Atomic Energy | D ₂ O | 200 | | | 1973 | | Site and
field prepn. |
| | | | | 200 | | | | | |
| CIRENE PROTYPE
Latina, Italy | CNEN, Italy | Ansaldo Meccanico
Nucleare, Italy | D ₂ O | 35 | | | (c) 1971 | | |
| KANUPP STATION
KARACHI NUCLEAR
POWER PROJECT)
Paradise Point,
Pakistan | Gov't. of Pakistan | Canadian General
Electric | D ₂ O | 123 | 132 | | (c) 1970 | | |

HW-FOREIGN (2)

LM-7

January 30, 1970

[illegible]

| BATTELLE NORTHWEST
BATTELLE MEMORIAL INSTITUTE
POST OFFICE BOX 999 RICHLAND WASHINGTON 99352 | | | NUCLEAR POWER PROJECTS SUMMARY
FOREIGN | | | | | | DATE
January 30, 1970 | |
|--|---|-------------------------------------|---|-----|-------|------|------------------------|----------------|---|--|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MW† | OPERATION | BURNUP
MWDT | REMARKS | |
| | | | | NET | GROSS | | | | | |
| DOEL STATION
Near Antwerp,
Belgium | SYNATOM (French-
Belgian combine)
Traction et
Electricite | ACEC, Cockrill-
Ougree, Framtome | PWR | 365 | 400 | 1192 | 1973 | | | |
| | | | | 365 | 400 | 1192 | 1975 | | | |
| KOZLUDY STATION
Kozludy, Bulgaria
(Danube River) | Gov't. of
Bulgaria | USSR | PWR | 400 | | | (c) 1972 | | | |
| | | | | 400 | | | 1974 | | | |
| RHEINSBERG STATION
Greitswald, East
Germany | German Democratic
Republic | USSR | PWR | 70 | | | 1966 | | | |
| LUBMIN STATION
Near Peenemunde,
East Germany
(Baltic Coast) | German Democratic
Republic
Atomkraftwerk
Nord | USSR
(Voronezh type) | PWR | 700 | | | (c) 1975 | | | |
| FINNISH STATION
Finland | Gov't. of Finland | USSR-Finland | PWR | 440 | 500 | | 1975 | | Negotiations
reportedly
completed. | |
| FRANCO-BELGE DES
ARDENNES STATION
Chooz, France
(Meuse River) | Societe d'Energie
Nucleaire Franco-
Belge des Ardenes
SENA | Westinghouse | PWR | 226 | 288 | 825 | (1967)

(d) 1970 | 14,700 | Coolant syst.
malfunction
Feb. 1968 | |
| PWR-FOREIGN (1) | | | | | | | | | | |

| BATTELLE NORTHWEST
BATTLE MEMORIAL INSTITUTE
POST OFFICE BOX 999 RICHLAND WASHINGTON 99352 | | NUCLEAR POWER PROJECTS SUMMARY
FOREIGN | | | | | | | DATE
January 30, 1970 |
|--|--|---|------|-----|-------|-------------------|-----------|----------------|--------------------------|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MW† | OPERATION | BURNUP
MWDT | REMARKS |
| | | | | NET | GROSS | | | | |
| TIHANGE STATION
Tihange (Near Liege), France
(Meuse River) | Synatom (France-Belgium) | Cockrill-Ougree,
Belgium, and ACEC
Contract award
1969 | PWR | 750 | 800 | | 1973 | | |
| PAKS STATION
Paks, Hungary
(Danube River) | Gov't. of Hungary | | PWR | 800 | | From two reactors | 1975 | | Planned |
| ENRICO FERMI STA.
Trino Vercellese,
Italy
(Po River) | Societa Elettro-
Nucleare Italiana
SELNI | Westinghouse | PWR | 252 | 290 | 825 | 1964 | | |
| MIHAMA STATION
Niu, Honshu,
Japan
(Tsuruga Peninsula) | Kansai Electric Power Co.
Do. | Westinghouse Contract award May 1966 | PWR | 325 | | | (c) 1970 | | |
| TAKAHAMA STATION
Takahama, Fukui,
Japan | Kansai Electric Power Co. | Mitsubishi, Japan | PWR | 500 | | | (c) 1972 | | |
| PWR-Foreign (2) | | Westinghouse Letter of intent, Oct. 1969 | PWR | 750 | 826 | | 1974 | | |

[illegible]

PWR-4

January 30, 1970

[illegible]

DATE
January 30, 1970

PWR-FOREIGN (5)

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| BATTELLE NORTHWEST
BATTELLE MEMORIAL INSTITUTE PACIFIC NORTHWEST LABORATORY
POST OFFICE BOX 999 RICHLAND WASHINGTON 99352 | | NUCLEAR POWER PROJECTS SUMMARY
FOREIGN | | | | | | DATE
January 30, 1970 | |
|--|--------------------------------------|---|------|---------------------------|-------|-------|-----------|--------------------------|-----------|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | M We | | M W t | OPERATION | BURNUP
MWD T | REMARKS |
| | | | | NET | GROSS | | | | |
| CORDOBA STATION
Argentina | Cordoba Province
Energy Agency | | | 150 | | | 1975 | | Planned |
| CANBERRA STATION
Canberra,
Australia | Australian Gov't. | | | 200 | | | 1975 | | Proposed |
| AUSTRIAN STATION | Austrian electric
power interests | | | 250
First of two units | | | 1977 | | Planned |
| LOMBARDY STATION
Italy | Italian State
Electricity Board | | | 700 | | | 1972 | | Announced |
| | | | | 700 | | | 1973 | | |
| SHIKOKU STATION
Japan | Shikoku Electric
Co. | | | 300-
500 | | | 1977 | | Planned |
| KYUSHU STATION
Chigasaki, Japan
(Kyushu Island) | Kyushu Electric
Power Co. | | | 500 | | | 1975 | | Planned |
| TOHOKU STATION
Honshu Island,
Japan | Tohoku Electric
Power Co. | | | 500 | | | 1975 | | Proposed |
| HOKURIKI STATION
Ishikawa, Japan | Hokuriki Electric
Power Co. | | | 500 | | | 1975 | | Planned |

PROJ-FOREIGN (1)

INFORMATION ON THIS CHART IS NOT INCLUDED IN THE SUMMARY

| BATTELLE NORTHWEST
BATTELLE MEMORIAL INSTITUTE PACIFIC NORTHWEST LABORATORY
POST OFFICE BOX 999 RICHLAND WASHINGTON 99352 | | NUCLEAR POWER PROJECTS SUMMARY
FOREIGN | | | | | | DATE
January 30, 1970
PROJ-2 | |
|--|--|---|------|------|-------|-----|-----------|------------------------------------|---|
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWDT | REMARKS |
| | | | | NET | GROSS | | | | |
| HOKAIDO STATION
Japan | Hokaido Electric
Power Co. | | | | | | | | Planned |
| TSURUGA HTR
Tsuruga, Japan | Power Reactor and
Nuclear Fuel
Development Corp. | | HTR | | | | 1974 | | Prototype
projected for
study |
| MEXICAN STATION | Govt. of Mexico,
Federal Electric
Commission | | | 600 | | | | | Nuclear island
specs, site
selection |
| GKN STATION
The Netherlands | Gemeenschappelijke
Kernenergiecentral
Nederland GKN | Tender from
Westinghouse and
Neratoom | | 300 | | | 1973 | | Bids
requested |
| PENISCOLA STATION
Castellon, Spain | Hidroelectrica
Espanola SA | | | 350 | | | | | Postponed |
| FENOSA STATION
Spain
(Mino River) | Fuerzas Electricas
de Nordests SA
FENOSA | | | 500 | | | | | Planned |
| IBERIAN STATION
Spain | JEN and companies
including U. S.
Bechtel.
Aquarius Co.
formed for
managing project | | | 1000 | | | | | Projected
agro-industry
complex in
S.E. Province
of Almeria |
| GAUDANIA STATION | Spain-Portugal | | | 500 | | | 1975 | | Planned |

NUCLEAR POWER PROJECTS SUMMARY
 FOREIGN

PROJ-3

DATE
 January 30, 1970

| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD/T | REMARKS |
|---|--|------------------|------|---------------------------|-------|------|-----------|-----------------|---|
| | | | | NET | GROSS | | | | |
| BARCELONA STATION | Enher, Fesca and
Hydroelectrica
Cataluna | | | 600 | | | 1980 | | Proposed dual
purpose
station |
| | | | | First of 1000 Mwe station | | | | | |
| LEMONIZ STATION
Near Bilbao,
Spain
(Bay of Biscay) | Iberduero, Spain | | | 1000 | | | 1979 | | First station
authorized -
bids requested |
| | | | | From two reactors | | | | | |
| ALMARAZ STATION
S. W. Spain
(Tagus River) | Spanish utilities
group: Hidro-
electrica Espanola,
UEM, Sevillana de
Electricidad | | | 500 | | | 1975 | | Planned |
| | | | | 500 | | | 1976 | | |
| GOTHENBURG STATION
Near Gothenburg,
Sweden | Swedish State
Power Board,
Gothenburg Energy
Board | | | 1500 | | | | | Proposed -
power and
process heat |
| | | | | From two reactors | | | | | |
| STOCKHOLM STATION
Vartan District,
Sweden | Swedish State
Power Board | | | 500 | | 1500 | 1975 | | Projected for
underground
construction,
power and
district heat |
| GARVLE STATION
Garvle, Sweden | Kraangede AB,
Sweden | | | 2200 | | | 1977 | | Postponed |
| | | | | From four reactors | | | | | |

PROJ-FOREIGN (3)

INFORMATION ON THIS CHART IS NOT INCLUDED IN THE SUMMARY

[illegible]

| BATTELLE NORTHWEST
<small>BATTELLE MEMORIAL INSTITUTE PACIFIC NORTHWEST LABORATORY</small>
<small>POST OFFICE BOX 999 RICHLAND WASHINGTON 99352</small> | | NUCLEAR POWER PROJECTS SUMMARY
FOREIGN | | | | | | DATE
January 30, 1970 | |
|--|--|---|------|-----|-------|-----|-----------|--|--|
| | | PROJ-5 | | | | | | | |
| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MW† | OPERATION | BURNUP
MWD · T | REMARKS |
| | | | | NET | GROSS | | | | |
| TURKEY STATION | Turkish Ministry
of Energy and
National Resources | Motor-Columbus,
Switzerland | | 400 | | | 1977 | | Contract
Aug. 1968 |
| EVS STATION
Eichau, W. Germany
(Rhine River) | Energie-Versorgung
Schwaben EVS,
Badenwerke AG | | | 750 | | | 1974 | | Approved |
| SCHMEHAUSEN STATION
Marl, W. Germany
(Lippe River) | VEW, Chemische
Werke Huls AG | | LWR | 600 | 650 | | 1975 | | Planned |
| LEVERKUSEN STATION
West Germany | Farbenfabriken
Bayer AG | | | 600 | | | 1975 | | For support of
fabrication
plants and
production of
steam a d
electricity |
| STUTTGART STATION
West Germany
(Neckar River) | Technische Werke
Stuttgart,
Nekarwerke AG,
Energi-Versorgung-
Schwaben EVS | | | 750 | | | 1976 | | Approved.
Original site
was Lauffen |
| UAR POWER AND
DESALINATION REACTOR
Mediterranean
Coast near
Burg-el-Arab, UAR | United Arab
Republic | Westinghouse -
letter of intent | PWR | 150 | | | | | |

PROJ-FOREIGN (5)

INFORMATION ON THIS CHART IS NOT INCLUDED IN THE SUMMARY

| <div> <div> <div>B</div> <div>BATTELLE</div> </div> <div> <div>NORTHWEST</div> <div> <small>BATTELLE MEMORIAL INSTITUTE
POST OFFICE BOX 999 RICHLAND WASHINGTON 99352</small> </div> </div> </div>		NUCLEAR POWER PROJECTS SUMMARY FOREIGN PROJ-6						DATE January 30, 1970	
REACTOR LOCATION	OWNER OPERATOR	NUCLEAR SUPPLIER	TYPE	M W e		M W t	OPERATION	BURNUP
MWD · T	REMARKS
				NET	GROSS				
MACEDONIA STATION
Near Skoplje
(Macedonia Prov.)
Yugoslavia | Macedonia Electric
Board, Yugoslavia
Elektrostopanstvo | | | 300 | | | | | Planned |
| SLOVENCA STATION
Videm Krsko in
Slovenca,
Yugoslavia | Yugoslavia | | | 600 | | | | | Planned -
site prepn. |
| CHILEAN STATION
Antofagasta
Province, Chile | Empresa Nacional
de Electricidad
SA. ENDESA,
Chilean Nuclear
Power Commission | | | 75 | | | | | Proposed for
training, and
power needs. |
| PROJ-FOREIGN (6) | | INFORMATION ON THIS CHART IS NOT INCLUDED IN THE SUMMARY | | | | | | | |

CUMULATIVE MWe (net)
 AS OF: January 30, 1970

NUCLEAR POWER PROJECTS SUMMARY

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
*										
DOMESTIC	4 056	9 096	17 198	29 963	46 075	54 278	63 278	69 091	74 571	74 571
ADDED	5 040	8 102	12 765	16 112	8 203	8 980	5 813	5 480		
TOTAL	9 096	17 198	29 963	46 075	54 278	63 278	69 091	74 571	74 571	74 571

*										
FOREIGN	8 839	13 707	17 577	25 042	31 467	39 701	48 196	49 510	51 360	52 110
ADDED	4 868	3 870	7 465	6 425	8 234	8 495	1 314	1 850	750	750
**										
TOTAL	13 707	17 577	25 042	31 467	39 701	48 196	49 510	51 360	52 110	52 860

TOTAL
DOMESTIC AND
FOREIGN	22 803	34 775	55 005	77 542	93 979	111 474	118 60	125 931	126 681	127 431

REMARKS:

* On-line as of Jan. 30, 1970

** Six of Britain's Magnox reactors are operating at reduced power-700 MWe

CHART INCLUDES REACTORS > 20 MWe IN OPERATION, UNDER CONSTRUCTION, CONTRACTED FOR.

PREPARED BY

TECHNICAL INFORMATION

PHONE 3611 EX. 39

11-11-11

11-11-11

BATTELLE

NORTHWEST

BATTELLE MEMORIAL INSTITUTE
POST OFFICE BOX 999PACIFIC NORTHWEST LABORATORY
RICHLAND WASHINGTON 99352

NUCLEAR POWER PROJECTS SUMMARY

FOREIGN PROJ-6

DATE

April 30, 1970

| REACTOR/LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | M W e | | M W t | OPERATION | BURNUP
MWD T | REMARKS |
|--|-------------------------------|---------------------|--------------------|-----------------|---------|-------|-----------|-----------------|--|
| | | | | NET | GROSS | | | | |
| OFF-SHORE STATION
Bay of Sagami,
Japan | Tokyo Electric
Power Co. | Hitachi | BWR | 1000 | | | | | Design work
underway-sea-
bed conditons
being deter-
mined |
| | | | | 1000 | | | | | |
| STAKE NESS STA.
Stake Ness,
Scotland | N. Scotland
Hydro-Electric | | AGR
or
SGHWR | 600 | | | 1977 | | Planned |
| | | | | 600 | | | | | |
| PROJ-FOREIGN (7) | | INFORMATION ON THIS | CHART IS NOT | INCLUDED IN THE | SUMMARY | | | | |

NUCLEAR POWER PROJECTS SUMMARY
FOREIGN PWR-5

DATE
 April 30, 1970

| REACTOR/LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MW† | OPERATION | BURNUP
MWD T | REMARKS |
|---|---|---|------|------|-------|------|-----------|-----------------|---|
| | | | | NET | GROSS | | | | |
| OBRIGHEIM STATION
Obrigheim, West
Germany
(Neckar River) | Kernkraftwerk
Obrigheim KWO
Do | Siemens, W. Germ. | PWR | 283 | | 908 | 1969 | 24,000 | |
| STADE STATION
Stade
(Neidersachsen)
West Germany
(Elbe River) | Kernkraftwerk
Stade | NPK and Siemens,
West Germany | PWR | 600 | | | (c) 1972 | | |
| BIBLIS STATION
Biblis, W. Germ.
(Upper Rhine R.) | RWE, W. Germany | Siemens (Kraft-
werk Union) | PWR | 1150 | 1200 | 3442 | 1974 | | Construction
1970 |
| LUDWIGSHAFEN STA-
Ludwigshafen
W. Germany | Badische Anilin
Und Soda Fabrik
BASF.
RWE may share in
project. | Kraftwerk-Union
(Siemens-AEG)
Letter of intent

Jan. 1970 | PWR | 600 | | | 1975 | | Site is a
chemical
manufacturing
complex |
| | | | | 600 | | | 1975 | | |
| PWR-FOREIGN (5) | | | | | | | | | |

| BATTELLE NORTHWEST
BATTELLE MEMORIAL INSTITUTE
POST OFFICE BOX 999 RICHLAND WASHINGTON 99352 | | NUCLEAR POWER PROJECTS SUMMARY
FOREIGN PWR-1 | | | | | DATE
April 30, 1970 | | |
|---|--|---|------|-----------|-------|------|------------------------|-----------------|---|
| REACTOR/LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD/T | REMARKS |
| | | | | NET | GROSS | | | | |
| DOEL STATION
Near Antwerp,
Belgium | SYNATOM (French-Belgian combine)
Traction et Electricite | ACEC, Cockrill-Ougree, Framtome | PWR | 365 | 400 | 1192 | 1973 | | |
| | | | | 365 | 400 | 1192 | 1975 | | |
| KOZLUDY STATION
Kozludy, Bulgaria
(Danube River) | Gov't. of Bulgaria | USSR | PWR | 400 | | | (c) 1972 | | |
| | | | | 400 | | | 1974 | | |
| RHEINSBERG STATION
Greitswald, East Germany | German Democratic Republic | USSR | PWR | 70 | | | 1966 | | |
| LUBMIN STATION
Near Peenemunde, East Germany
(Baltic Coast) | German Democratic Republic
Atomkraftwerk Nord | USSR
(Voronezh type) | PWR | 700 | | | (c) 1975 | | |
| LOVISA STATION
Lovisa Finland | Imatran Voima Oy, Finland | USSR-Finland | PWR | 440 | 500 | | 1975 | | Negotiations reportedly completed |
| FRANCO-BELGE DES ARDENNES STATION
Chooz, France
(Meuse River) | Societe d'Energie Nucleaire Franco-Belge des Ardenes
SENA | Westinghouse | PWR | (226) | 288 | 825 | (1967) | 14,700 | Coolant syst. malfunction
Feb. 1968
On-line at 70 MWe April 1970 - (fall) |
| | | | | <u>70</u> | | | <u>1970</u> | | |
| PWR-FOREIGN (1) | | | | | | | | | |

B BATTELLE BATTELLE MEMORIAL INSTITUTE POST OFFICE BOX 999 RICHLAND WASHINGTON 99352 NORTHWEST PACIFIC NORTHWEST LABORATORY POST OFFICE BOX 999 RICHLAND WASHINGTON 99352		NUCLEAR POWER PROJECTS SUMMARY				DATE	
REACTOR/LOCATION	OWNER OPERATOR	NUCLEAR SUPPLIER	TYPE	MWe		MW†	OPERATION
				NET	GROSS		
AACHEN FAST REACTOR
Aachen, W. Germ.	Rheinisch-West-faelische Elektrizitaetswerk (RWE, Synatom (Belgium), and Samenwerkende Electriciteits-Productiebedrijven (Holland)		Liq. metal fast	300			1976
LM-FOREIGN (2)							
						BURNUP
MWDT	REMARKS

NUCLEAR POWER PROJECTS SUMMARY
 FOREIGN HW-2

DATE

April 30, 1970

| REACTOR/LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MW† | OPERATION | BURNUP
MWD T | REMARKS |
|--|--|--------------------------------------|---------------------------|-----|-------|-----|-----------|-----------------|-------------------------------|
| | | | | NET | GROSS | | | | |
| SGHWR (STEAM GEN.
HEAVY WATER REACTOR)
Winfrith Heath,
England | Atomic Energy
Authority, Gt.
Britain UKAEA | UK AEA | D ₂ O | 90 | | 295 | (d) 1970 | | Fuel failures
in Nov. 1968 |
| LAVRION STATION
Lavrion, Greece | Public Power
Corp., Greece | UK AEA | D ₂ O
SGHWR | | | | | | Plans dropped |
| RAPP STATION
(RAJASTHAN ATOMIC
POWER PROJECT
Rana Pratap
Sugar, India
(Reservoir) | Gov't. of India | Canadian General
Electric | D ₂ O | 200 | | | (c) 1970 | | |
| | | | | 200 | | | (c) 1974 | | |
| KALPAKKAM STATION
Kalpakkam, India | Gov't. of India | India Dept. of
Atomic Energy | D ₂ O | 200 | | | 1973 | | Site and
field prepn. |
| | | | | 200 | | | | | |
| CIRENE PROTYPE
Latina, Italy | CNEN, Italy | Ansaldo Meccanico
Nucleare, Italy | D ₂ O | 35 | | | (c) 1971 | | |
| KANUPP STATION
KARACHI NUCLEAR
POWER PROJECT)
Paradise Point,
Pakistan | Gov't of Pakistan | Canadian General
Electric | D ₂ O | 123 | 132 | | (c) 1970 | | |
| HW-FOREIGN (2) | | | | | | | | | |

NUCLEAR POWER PROJECTS SUMMARY
 FOREIGN GCR-2

DATE

April 30, 1970

| REACTOR/LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MW† | OPERATION | BURNUP
MWD/T | REMARKS |
|---|-------------------|----------------------------------|---------------------------------|-------------------|-------|------|--------------------------|-----------------|---|
| | | | | NET | GROSS | | | | |
| MONT D'ARREE STA.
(EL-4)
Brennilis,
Brittany, France | CEA, France | CEA, France | GCR
D ₂ O
mod. | 70 | | 250 | (1967)

(d) 1970 | | Down due to
weld cracks
in heat
exchanger |
| SAINT LAURENT DES
EAUX (EDF-4)
Loir-et-Cher
(Orleans),
France | EDF, France | EDF, France | GCR | 480 | 500 | 1650 | (1969)

(d) (1970) | | Down due to
fuel melting
accident Oct.
1969 |
| | | | | 480 | 500 | | (c) 1971 | | |
| BERKELEY STATION
Berkeley, Eng. | CEGB, Gt. Britain | AEI-JT, Gt. Brit. | GCR | 276 | | 1120 | 1962 | 3,000 | Partial refuel
weekly |
| | | | | From two reactors | | | | | |
| BRADWELL STATION
Bradwell-on-Sea,
England | CEGB, Gt. Britain | The Nuclear Power
Group TNPG | GCR | (300)

150 | | 1076 | 1962 | 3,000 | One reactor
down for
modification
April 1970 |
| HINKLEY POINT STA.
Hinkley Point,
Somerset, Eng. | CEGB, Gt. Britain | Atomic Power
Group, Gt. Brit. | GCR | 500 | | 960 | 1964 | 3,000 | |
| | | | | From two reactors | | | | | |
| | | The Nuclear Power
Group TNPG | AGR | 650 | | | (c) 1972 | | |
| | | | | 650 | | | (c) 1973 | | |
| GCR-FOREIGN (2) | | | | | | | | | |

NUCLEAR POWER PROJECTS SUMMARY

DATE

April 30, 1970

FOREIGN

BWR-5

| REACTOR LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWDT | REMARKS |
|--|--|--|----------------------------------|-----|-------|-----|-----------|----------------|----------------------|
| | | | | NET | GROSS | | | | |
| KAISERAUGST STA.
Near Basle,
Switzerland
(Rhine River) | French, Swiss and
German interests:
EDG (France)
Motor-Columbus
and Aluminum SA
(Switz),
RWE (Germany) | GE, Brown Boveri,
Sogerca | BWR | 800 | | | 1972 | | To be ordered |
| RHEINSCHANZINSEL
ISLAND STATION
Rheinschanzinsel
Island, near
Oberhausen, W.
Germany
(Rhine River) | Badenwerk AG,
Energie-Versorgung-
Schwaben (EVS) | Kraftwerk Union
Letter of intent
Feb. 1970 | BWR | 900 | | | 1974 | | Site changed |
| ATR (Advanced
Thermal Reactor)
Japan | Gov't. of Japan | | BWR,
D ₂ O
Mod. | 200 | | | 1974 | | Construction
1970 |
| BWR-FOREIGN (5) | | | | | | | | | |

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FOREIGN BWR-4 | | | | | | DATE
April 30, 1970 | |
|--|--|--|------|-----|-------|------|-----------|------------------------|-----------------------|
| REACTOR/LOCATION | OWNER/OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWt | OPERATION | BURNUP
MWD/T | REMARKS |
| | | | | NET | GROSS | | | | |
| KRB STATION
(RWE-BAYERNWERK)
Gundremingen,
W. Germany
(Danube River) | Kernkraftwerk
RWE-Bayernwerk
KRB
W. Germany | Allgemeine Elek-
trizitats Gesell-
schaft AEG
W. Germany | BWR | 237 | 250 | 801 | 1966 | | |
| LINGEN STATION
Munsten, West-
phalia, West
Germany
(Dortmund-Ems
Canal) | Kernkraftwerk
Lingen, W. Germ.
Vereinigte
Elektrizitats-
werk Westfalen
VEW | AEG, W. Germany | BWR | 240 | | 514 | 1968 | | |
| WUERGASSEN STATION
Hoextra, West
Germany
(Weser River) | Preussen Elektra | Allgemeine
Elektrizitats
Gesellschaft AEG
Contract award
July 1967 | BWR | 640 | | 1912 | (c) 1972 | 27,500 | |
| ULYANOVSK STATION
Melekess, USSR
(Volga River) | USSR | USSR | BWR | 60 | | 250 | 1965 | | |
| BELOYARSK STATION
Beloyarsk Urals,
USSR | USSR | USSR | BWR | 100 | | 286 | 1964 | 4,000 | On line
April 1970 |
| | | | | 200 | | 560 | 1970 | | |
| BWR-FOREIGN (4) | | | | | | | | | |

| BATTELLE NORTHWEST
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DOMESTIC | | | | | DATE
April 30, 1970 | | |
|--|---|--|------|---------------------------|-------|-----|------------------------|-----------------|--|
| REACTOR/LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | MWe | | MWT | OPERATION | BURNUP
MWD/T | REMARKS |
| | | | | NET | GROSS | | | | |
| WARD MANOR STATION
Ward Manor, N.Y.
South of Tivoli | Central Hudson
G & E | | | | | | 1975 | | Planned - may
be deferred. |
| KIKET ISLAND STA.
Kiket Island,
Puget Sound | Seattle City Light
Snohomish County
PUD | | | 1000 | | | | | Proposed for
1980 constr. |
| SAN ONOFRE-2 | Southern Calif.
Edison | | | 1100 | | | 1976 | | Bid evaluation |
| McNARY STATION
Umatilla, Ore.
(Columbia R.) | Port of Umatilla | | | 1000 | | | | | Proposal.
Project would
irrigate with
cooling water
from the
plant. |
| COM-ED STATION
Illinois | Commonwealth Ed. | | | 1100
From two reactors | | | 1976-1977 | | Contract award
imminent |
| RUSSELLVILLE-2
Russellville, Ark | Mid-South
Utilities | | | 1000 | | | 1976 | | Tentative
proposal |
| PROJ-DOMESTIC (3) | | INFORMATION ON THIS CHART IS NOT INCLUDED IN THE SUMMARY | | | | | | | |

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NUCLEAR POWER PROJECTS SUMMARY

DOMESTIC

BWR-1

DATE

April 30, 1970

| REACTOR/LOCATION | OWNER OPERATOR | NUCLEAR SUPPLIER | TYPE | M W e | | M W t | OPERATION | BURNUP
MWD. T | REMARKS |
|---|--------------------------------|------------------|------|-------------|-------|-------|-----------|------------------|---|
| | | | | NET | GROSS | | | | |
| DRESDEN STATION
Morris, Illinois
(Kankakee and
Des Plaines R.) | Commonwealth Ed.
Do | General Electric | BWR | 184 | 200 | 700 | 1960 | 10,000 | Refueled June
1968 |
| | | | | (715)
40 | (809) | 2300 | (t) 1970 | | 40 MWe April
1970 |
| | | | | 715 | 809 | 2300 | (c) 1970 | | |
| BIG ROCK POINT
Charlevoix,
Michigan
(Lake Michigan) | Consumers Power
Do | General Electric | BWR | 71 | 50 | 240 | 1962 | | Refueled
Feb. 1968
March 1969
Due May 1970 |
| HUMBOLDT BAY STA.
Eureka, Calif.
(Humboldt Bay) | Pacific G & E | General Electric | BWR | 60 | 70 | 165 | 1964 | 10,000 | Partial fuel
March 1968 |
| PATHFINDER STATION
Sioux Falls,
S. Dakota
(Big Sioux R.) | Northern States
Power | Allis-Chalmers | BWR | | | | 1966-1968 | | Closed down
fall 1968 |
| LA CROSSE STATION
Genoa, Wisconsin
(Mississippi R.) | Dairyland Power
Cooperative | Allis-Chalmers | BSR | 50 | 60 | 155 | 1968 | | Restarted
Aug. 1969 |
| BWR-DOMESTIC (1) | | | | | | | | | |

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<small>POST OFFICE BOX 999 / RICHLAND, WASHINGTON 99352</small> </div> </div> </div> </div>		CUMULATIVE MWe (net) AS OF: April 30, 1970		NUCLEAR POWER PROJECTS SUMMARY				

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
* DOMESTIC	3 617	9 832	17 219	29 964	46 076	54 279	63 902	68 542	74 022	74 022
ADDED	6 215	7 387	12 745	16 112	8 203	9 623	4 640	5 480		
TOTAL	9 832	17 219	29 964	46 076	54 279	63 902	68 542	74 022	74 022	74 022

* FOREIGN	7 748	12 862	16 767	25 132	31 547	38 636	47 131	48 445	50 295	51 045
** ADDED	5 114	3 905	8 265	6 415	7 089	8 495	1 314	1 850	750	750
TOTAL	12 862	16 767	25 132	31 547	38 636	47 131	48 445	50 295	51 045	51 795

TOTAL DOMESTIC AND FOREIGN	22 694	33 986	55 096	77 623	92 915	111 033	116 987	124 317	125 067	125 817

REMARKS:

* On-line as of April 30, 1970

*

* Six of Britain's Magnox reactors are operating at reduced power.

CHART INCLUDES REACTORS > 20 MWe OPERATING, UNDER CONSTRUCTION, CONTRACTED FOR.

PREPARED BY

TECHNICAL INFORMATION

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