AIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

DECLASSIFIED

HW-58946

13

January 20, 1959

GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

X

[X] RESTRICTED
THIS DOCUMENT CONTAINS RESTRICTED DATA AS
DEFINED IN THE ATOMIC ENERGY ACT OF 1946
ITS TRANSMITTAL OR DISCLOSURE OF
CONTENTS IN ANY MANNER TO AN UNAUTHORIZED
PERSON IS PROHIBITED.

IRRADIATION PROGRAM FOR CANDIDATE

105-N GRAPHITES

CIRCULATING COPY
RECEIVED 300 AREA

FEB 12 1959

RETURN 10

TECHNICAL INFORMATION FILES

☐ OTHER OFFICIAL CLASSIFIED INFORMATION

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U. S. C., SECS. 793 AND 794, THE TRANSMISSION OR REVELATION OF WHICH IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

E. M. Woodruff

THIS DOCUMENT MUST BE KEPT UNATTENDED OR WHERE AN UNAUTHORIZED PERSON MAY HAVE ACCESS TO IT. WHEN NOT IN USE, IT MUST BE STORED IN AN UNCLASSIFIED LOCKED RECEPTACLE WITHIN AN UNCLASSIFIED SECURED AREA. WHILE IT IS YOUR POSSESSION, UNTIL YOU HAVE OBTAINED A SIGNED REPORT FROM THE ISSUING OFFICE, IT IS YOUR RESPONSIBILITY TO KEEP IT AND ITS CONTENTS WITHIN THE LIMITS OF THIS POLICY AND FROM ANY UNAUTHORIZED PERSON. ITS TRANSFER TO, AND STORAGE AT YOUR PLACE OF BUSINESS IS PROHIBITED. IT IS NOT TO BE DUPLICATED. IF ADDITIONAL COPIES ARE REQUIRED, OBTAIN THEM FROM THE RELATING ISSUING FILE. ALL PERSONS READING THIS DOCUMENT ARE REQUESTED TO SIGN IN THE SPACE PROVIDED BELOW.

[illegible]

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DECLASSIFIED

(CLASSIFICATION)

DECLASSIFIED

HW-58946

This Document consists of
13 Pages No. 13 of
33 Copies Series

IRRADIATION PROGRAM FOR CANDIDATE

105-N GRAPHITES

By

E. M. Woodruff

Classification Cancelled and Changed To

DECLASSIFIED

By Authority of DS Lewis

CG-PR-2 12-20-93

January 20, 1959

By J. E. Savely 1-6-94

Verified By J. M. Mally 1-24-94

DISTRIBUTION:

1. F. W. Albaugh	13. J. L. Jackson
2. D. E. Baker	14. K. Koyama
3. R. W. Benoliel	15. G. L. Locke
4. A. G. Blasewitz	16. C. E. Love
5. T. J. Clark	17. D. Marinos
6. R. F. Corlett	18. R. E. Nightingale
7. D. H. Curtiss	19. R. E. Trumble
8. R. E. Dahl	20. F. W. Woodfield
9. J. M. Davidson	21. E. M. Woodruff
10. R. L. Dickeman	22. H. H. Yoshikawa
11. J. E. Faulkner	23.-33. Extra
12. J. W. Helm	

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

RESTRICTED DATA

This document contains restricted data as defined in the Atomic Energy Act of 1954. Its transmittal or disclosure of its contents in any manner to unauthorized persons is prohibited.

MASTER

DECLASSIFIED

IRRADIATION PROGRAM FOR CANDIDATE 105-N GRAPHITESIntroduction

Selection of new graphites for nuclear reactor moderator applications can be accomplished either by: (1) an evaluation of the behavior of untested materials processed by proven methods of manufacture when tested under conditions typical of the proposed application, or, (2) a development program exploring new materials, processes and environments which results in graphites meeting or exceeding design requirements. The latter approach is not easily adapted to construction schedules and therefore can at this date contribute little to the 105-N program. Its importance cannot be overlooked, however, if future reactor designs are not to be limited by problems currently associated with graphite.

The program for selecting 105-N reactor graphite is governed basically by two factors:

1. Dimensional stability of graphite under the proposed operating conditions is the major design requirement to be met.⁽¹⁾
2. The types of petroleum coke and processes used in manufacturing artificial graphites directly influence their behavior under irradiation.

Since the evaluation and procurement of graphite for the 100-K reactors, carbon companies have established a number of new coke sources. Some major changes in processing graphite have also been developed; however, these have not reached full production scale and cannot be considered sources for 105-N graphite. Consequently, candidate graphites for the 105-N reactor are those representing the new coke sources plus Texas Lockport coke, the only previously evaluated coke now available, processed with only minor variation of methods used in the past.

The program for irradiation testing these graphites is presented here to indicate its capabilities and limitations in providing information for the selection of 105-N graphite. Graphite irradiations supporting present Hanford operations and the development of graphites for future applications are included to indicate total utilization of the available irradiation facilities. It should be noted that a schedule for irradiations in the L-48 position of the MTR and the N-14 and E-5 positions of the ETR is included with the assumption that these facilities, when activated, will be operable and will provide useful data after a brief calibration period. This assumption may be especially optimistic for the N-14 and E-5 facilities since they are of a new design and will be the first graphite irradiations in the ETR.

Discussion

Coke Variations. It has been shown through irradiations of the various graphites used in the construction of Hanford reactors that their relative dimensional stability is dependent in part on the coke source.⁽²⁾ This is true for irradiations at 500° C as well as those at 30° C; however, those graphites which expand at the highest rate

at 30° C have the lowest contraction rates at 500° C. Kendall coke graphite is the best example of this type of graphite and would be desirable for 105-N construction in the regions providing structural support where it is estimated graphite temperatures in the support tiers will be 800° C or less.⁽³⁾ Kendall coke is no longer available; however, its unique properties were desirable for other graphite products, and attempts to produce other cokes like it have been made by the carbon companies. They might be described as the softest of the soft cokes, those formed from organics remaining fluid to about 400° C and more easily graphitized than the hard cokes made from materials which remain solid throughout coking.^(4,5) Methods for altering refinery operations to produce these cokes have been investigated by Great Lakes Carbon Corporation and National Carbon Company and the resulting cokes available in commercial quantities are being evaluated for use in the 105-N graphite.

Table I lists all the graphites from new cokes being evaluated with a brief description of each. Those of particular interest because of their similarity to the old Kendall coke are designated GL-6, GL-7, GL-10, and GL-11 from Great Lakes Carbon Corporation, and the RC and CO graphites from National Carbon Company.

It cannot be assumed that these graphites will have the characteristics of Kendall coke graphite until irradiation testing is completed. For this reason all available coke sources are being evaluated. It is possible that some of these will be as good as Kendall and that others will provide alternate sources of material as good or better than Texas Lockport coke.

Table II lists all of the remaining graphites currently being irradiated. Included are those used in previous Hanford reactor construction and experimental types.

Process Variations. All candidate 105-N graphites are graphitized at temperatures of from 2700 to 2800° C. "GBF" processing at 2450° C used for some previous reactors does not produce the highly graphitic structure considered to be more dimensionally stable for high temperature applications.

Variations in purification techniques are being studied by the carbon companies; however, those samples in which the graphite structure has not also been altered have not been scheduled for irradiation and have not been included in Table I. Speer Carbon Company has demonstrated that an iron oxide additive in the base mix did not effect final purity when their chlorine purification process was used. Because this addition results in a graphite of increased density without costly pitch impregnation and there may be some effect on dimensional stability, samples have been included in the irradiation program. They are SP-5, SP-6, and SP-10 in Table I.

When the program for irradiation of candidate graphites was initiated, samples were submitted by the carbon companies as rapidly as possible to allow maximum irradiation time. In some cases graphites representing new cokes were only available in 16 inch round electrode stock or were quickly processed in a development lab as two-inch round extrusions. The primary differences between these samples and the 4 x 4 inch extrusions used in reactor construction are the particle size and the degree of preferred orientation of graphite crystallites. Since irradiation characteristics could be altered by either of these, samples of similarly processed Texas coke graphite were included as bases for comparison. Processing of 4 x 4 inch extrusions

of the same materials was initiated at the same time to provide samples typical of both material and processing that might be used for 105-N construction. Irradiation of the 4 x 4 inch extrusions is phased into later stages of the irradiation schedule (Figure 1).

Irradiation Facilities

Graphite irradiation facilities available are listed in Table III with brief descriptions. Those which are at this date being prepared for use are: the 2C uncooled test hole at KE, IP-22, MTR L-48 Shim Rod Conversion, and ETR positions E-5 and N-14. As previously stated, the satisfactory operation of the new MTR, ETR facilities has not been proven. Installation of the shim rod conversion in L-48 at the MTR is dependent on satisfactory completion of tests to be made on the connecting mechanism which makes the conversion possible. The L-48 sample heating and temperature monitoring systems are the same as those proven in the L-42 irradiations.

The new ETR facilities will require testing in the ETR critical assembly. The assembly consists of a series of flexible spiders which center cylindrical graphite samples. The sample holding assembly has not been previously tested under irradiation and will possibly undergo minor changes based on the first irradiation results. Modification of this system for the irradiation of samples under a compressive load should not be too difficult and has been included as a possibility in the irradiation schedule (Figure 1).

The 2C at KE utilizes a test position similar to that being used in 105-C. Activation requires fabrication of graphite sample carriers, shield plugs, retrieving tools and shielded storage facilities. This work is 50 per cent complete at this date. Special boats for irradiating samples under compression have not been tested and may require further development. Spacer boats for the fringe region and sample holding boats will be miked for full-bar length data. Some of the new graphites from cokes similar to Kendall will be used in the fabrication of sample holding boats.

IP-22, previously known as PT-403, is being reactivated with an improved temperature control system. Fabrication of parts is complete and assembly is in progress. The predicted charge date of March 1, 1959 is firm. An initial exposure of one year's duration with an accumulated exposure of approximately 2000 MWD/AT has been scheduled.

The usefulness of the water cooled Hanford facilities for the 105-N graphite evaluation is limited since the minimum graphite temperatures in 105-N are predicted to be $> 200^{\circ}\text{C}$.⁽⁶⁾ The data obtained, however, may prove very useful in an indirect way. The expansion with low temperature irradiation is of much greater magnitude than high temperature contraction and tends to amplify differences in the graphites being studied.⁽²⁾

Sampling Methods

A standard size (.426" diameter X ~4" long) sample is used almost exclusively in all irradiations. Samples are taken from the full bar with cuts parallel and perpendicular to its axis of extrusion. Measurements made on the samples are:

DECLASSIFIED

1. Length.
2. Thermal conductivity.
3. Electrical resistivity.
4. Crystallite size and C_0 lattice space.
5. Weight.
6. Thermal expansion.

Not all of these measurements are made on each sample charged into the Hanford facilities carrying hundreds of samples. This may be contrasted with the IP-22 or MTR facilities where it is common practice to make every measurement possible.

Exposures in the Hanford facilities are determined from the power generation of adjacent fuel channels. There are uncertainties involved in the conversion of MTR and ETR exposures to equivalent Hanford exposures due to flux spectrum differences. The methods currently in use are discussed in reference 2.

In the large Hanford facilities both parallel and transverse cut samples are charged for each type of graphite. Samples of well-known graphites are charged in adjacent positions for direct comparison. For example, the loading of GL-6 samples, (Table I) in the Y at C, (Figure 1) scheduled for an exposure of 2000 MWD/AT, consists of four transverse and four parallel samples. In the same boat are four parallel and four transverse CSF standards.

Each ETR assembly will contain eight samples similar to those charged into Hanford facilities. Temperature and flux will vary from one sample to the next. Direct comparison with a standard graphite must be obtained through successive loadings. Only transverse cut samples will be charged during the first cycles.

The MTR samples are wafers one inch across the face. Length measurements are made by micrometer from edge to edge and by traveling microscope between scribed platinum pins.

Irradiation Schedule

To meet the construction schedule, selection of the graphite to be used in supporting tiers must be completed by December 31, 1959. It is possible that prior to that date graphites may be specified for less critical regions of the reactor.

Figure 1 presents the irradiations now in progress or scheduled. The numbered groups within each test hole charge represent samples having similar exposure history or similar schedules if they were not previously irradiated. Graphite types included in each group may be determined by referring to Tables I and II. Estimated accumulated exposures at the time of discharge are given for the Hanford facilities. Further explanation for each group will be given to indicate the reasons for charging and the results expected.

2 B at KE

1. This group includes reactor graphites with previous cold test hole exposures up to 8000 MWD/AT. Saturation of expansion may be indicated after this exposure.
2. New cokes charged to determine differences not made apparent by hot test hole irradiations.
3. A few samples with hot test hole exposures up to 5000 MWD/AT for a short cold irradiation to study fundamental damage mechanisms. The coated samples will determine radiation levels to be expected in future hot test hole irradiations. Japanese irradiations are an off-site service but their graphites show characteristics that may be of interest to the Hanford program (apparent density, 1.78).

2 B at KW

1. Japanese graphites at 80° C.
2. New cokes in 4 x 4 extrusions for a 30° C irradiation.

Y at C

1. Reactor grade graphites with previous hot test hole exposure of 5100 MWD/AT.
2. The early new cokes with standards for the highest possible exposure in a Hanford facility before 105-N graphite selection is made.
3. A previously irradiated new coke and several pressure molded, resin impregnated types.
4. A temperature of graphitization series which may provide information on the saturation of high temperature contraction. The samples with low graphitization temperatures contract at accelerated rates.
5. Duplicates 2 in this facility but will provide two intermediate exposures for establishing a contraction rate. The first exposure will give a point near maximum expansion before contraction. They will be recharged for another point near the "crossover" for most graphites. Information gained from the first exposure will be used to determine which graphites will be charged in the ETR, MTR facilities.

2 C at KE

1. New cokes in 4 x 4 extrusions with standards for the longest possible exposure before 105-N graphite selection. The D-58 samples are more recent variations of the D-57 samples in Y at C.
- 2-3. Samples under compressive loads with unstressed standards to determine the effect of stress on contraction rates.

4. Graphite samples in quartz containers. Some quartz capsules will be evacuated to determine the dimensional stability of graphite in the absence of oxidation. Containers with graphite and high pressure atmospheres will provide preliminary data for studies in the PRTR Gas Loop.
5. Coated graphites in support of studies for the Gas Cooled Reactor Program.

IP-22

CSF was selected because it was used in PT-403 and has been thoroughly tested.

MTR L-42

- 1-2. Standard graphites being studied at high temperature (650 to 1100° C) to determine MTR-Hanford exposure equivalence as well as temperature dependence of contraction.
3. By this time the 105-N graphite should have been selected and a series of exposures to predict the effect of reactor operating conditions throughout the reactor life will be initiated.

ETR E-5

1. Standard samples for calibration.
2. A new coke selected on the basis of Y at C data with KC for comparison.
3. Correlate KC with CSF calibration.
4. Promising alternate cokes.
5. Assuming the facility can be adapted for loading samples, tests of this nature can be started. Some preliminary data from the 2C at KE will aid in establishing the type of test necessary here.
6. 105-N graphite for very high exposure.

ETR N-14

Parallels the E-5 irradiations with the exception of a long exposure for the most promising new coke. Should the charge dates for the two ETR facilities become staggered, it may be possible to recharge samples coming out of one facility into the next assembly being fabricated.

MTR L-48

1. Calibration with standard graphites.
2. KC and the new coke used in ETR E-5, 2, if it still looks promising.
3. Alternate promising cokes.

DECLASSIFIED W-58946

References

1. HW-57654, "Discussion of NPR Contraction," R. F. Corlett, October 2, 1958.
2. HW-57900, "High Temperature Radiation Induced Graphite Contraction," J.M. Davidson, E.M. Woodruff, and H.H. Yoshikawa.
3. HW-57735, "Technical Criteria and Bases Pressurized, Water Cooled, Graphite Moderated Production Reactor," R.L. Dickeman, October 9, 1958.
4. "Structure and Graphitization of Fine Coke Particles and of Thermal Carbon Blacks," E.A. Kmetko, Proceedings of the First and Second Conferences on Carbon, 1953, 1955.
5. "Mechanical Strength, Thermal Expansion and Structure of Cokes and Carbons," S. Mrozowski, Proceedings of the First and Second Conferences on Carbon, 1953-1955.
6. HW-57043 RD 3, "100-N Design Bases—Part I—General," E.R. Astley, G.L. Locke, January 19, 1959.

TABLE I
Sample Irradiations for the 105-N Graphite Evaluation

<u>Sample Number</u>	<u>Supplier</u>	<u>Sample Description</u>		<u>Formulation</u>	<u>Irradiation Facility</u>
		<u>Coke Source</u>	<u>Size of Piece Sampled</u>		
GL 6	Great Lakes Carbon Corp.	Proprietary information	10" diameter X 60" long	Electrode stock; large particles; unimpregnated, density 1.47; refinery process altered to produce Kendall-type coke.	Y at C
GL 7	Great Lakes Carbon Corp.	Continental	10" diameter X 60" long	Same as GL 6	Y at C
GL 8	Great Lakes Carbon Corp.	Texas Lockport	4 x 4 x 50"	Fine grained impregnated mold stock	Y at C
GL 10	Great Lakes Carbon Corp.	Same as GL 6	4 x 4 x 50"	Standard AGOT type process	2C at KE
GL 11	Great Lakes Carbon Corp.	Continental	4 x 4 x 50"	Standard AGOT type process	2C at KE
VT	National Carbon Co.	Sunray	4 x 4 x 50"	Standard AGOT processing, density 1.72.	2B at KE Y at C
RO	National Carbon Co.	Ohio	2" diameter x 8" long	AGOT processed in development lab. Refinery process controlled for uniform coke.	Y at C 2B at KE
RC	National Carbon Co.	Continental	2" diameter x 8" long	AGOT processed in development lab. Refinery process altered to produce Kendall-type coke.	Y at C 2B at KE
RS	National Carbon Co.	Socony Vacuum Mobil	2" diameter x 8" long	AGOT processed in development lab.	Y at C 2B at KE
RT	National Carbon Co.	Texas Lockport	2" diameter x 8" long	AGOT processed in development lab for comparison with new cokes in 2" round	Y at C 2B at KE
OO	National Carbon Co.	Ohio	4 x 4 x 50"	AGOT processed, coke same as in RO, processed for uniformity.	Y at C
CO	National Carbon Co.	Continental	4 x 4 x 50"	AGOT processed, coke same as in RC, processed for Kendall-type coke.	2C at KE
SV	National Carbon Co.	Socony Vacuum Mobil	4 x 4 x 50"	AGOT processed, coke same as in RS	2C at KE
SP 5	Speer Carbon Company	Texas Lockport	16" diameter x 48" long	Iron oxide added in mix, chlorine purified.	2B at KE Y at C
SP 6	Speer Carbon Company	Sohio Lima	16" diameter extrusion cut to 5x5x50" at bake stage then graphitized	Iron oxide added in mix, chlorine purified.	2B at KE Y at C
SP 7	Speer Carbon Company	Texas Lockport	4 x 4 x 50"	Standard process, chlorine purified and let down in argon	2C at KE
SP 9	Speer Carbon Company	Sohio Lima	4 x 4 x 50"	Same as SP 7, except for coke.	2C at KE
SP 10	Speer Carbon Company	Texas Lockport	4 x 4 x 50"	Same as SP 6, except iron oxide added in base mix.	2C at KE

DECLASSIFIED

HW-58946

TABLE II
Graphite Irradiations for Purposes Other Than 105-N Evaluation

<u>Sample Number</u>	<u>Source</u>	<u>Type of Graphite</u>	<u>Reason For Irradiation</u>	<u>Irradiation Facility</u>
KC	National Carbon Company	Reactor grade, AGOT processed Kendall coke graphite.	Monitor reactor graphite damage trends; standard for comparison.	2B at KE; Y at C; ETR E-5; ETR N-14. 2C at KE.
CSF	National Carbon Company	Reactor grade, Cleves coke, standard pitch, "F" purified at 2700° C.	Monitor reactor graphite damage trends; standard for comparison.	2B at KE; Y at C; 2C at KE; MTR-L 42; MTR-L 48 ETR E-5; ETR 4-14. IP-22.
CSGBF	National Carbon Company	Same as "CSF," except "GBF" purified at 2450° C.	Monitor reactor graphite damage trends.	2B at KE Y at C
TSGBF	National Carbon Company	Reactor grade, Texas Lockport coke, "GBF" purified at 2450° C.	Monitor reactor graphite, standard for comparisons.	2B at KE; Y at C; 2C at KE; MTR L-42; MTR L-48; ETR E-5; ETR H-14.
SGBF	Speer Carbon Company	Same as TSGBF, except different supplier.	Monitor reactor graphite.	2B at KE; Y at C.
E Series	Battelle Memorial Institute	Experimental molded Texas coke temperature of graphitization series (1300 to 2800° C)	Observe dependence on graphitization temperature and saturation of contraction.	Y at C
D 57 and D 58	National Carbon Company	Several impermeable graphites formed by new process.	Evaluate for future applications.	Y at C 2C at KE
HTH		Reactor grades irradiated at high temperature	Determine effects of low temperature irradiation.	2B at KE
GL 9	Great Lakes Carbon Corp.	Impermeable type by new process.	Evaluate for future applications.	2C at KE
J 2, 3, and 4	Tokai Electrode through Japanese government and AEC	Molded and extruded; 2 and 4 AGOT type processing; 3 apparently purified	Offsite service	2B at KE
SP 1	Speer Carbon Company	Low density graphite	Observe density effect	Y at C
L	National Carbon Company	Low density graphite	Observe density effect	Y at C

TABLE III
GRAPHITE IRRADIATION FACILITIES

<u>Irradiation Facility</u>	<u>Location</u>	<u>Sample Type and Capacity</u>	<u>Temperature Range & Control</u>	<u>Advantages</u>	<u>Limitations</u>
2B at KE	Filler Layer 105-KE	390 samples .426" diameter x 4" long charged in aluminum casings.	water cooled to 30° C.	Large capacity; fair temperature control; exposure in Hanford flux.	Low temperature is not applicable to current or proposed operating conditions, sample diameter limited.
2B at KW	Filler layer 105-KW	Same as 2B at KE	water cooled—can be controlled at temperatures between 30 and 90° C.	Large capacity, good temperature control, exposure in Hanford flux.	Same as 2B at KE.
Y at C	Filler layer 105-C	~300 samples .426 x 4" long charged into graphite boats	ambient filler block temperature 500 to 600° C.	Large capacity at ambient temperature in Hanford flux. Sample boats can also be used for length data. With special boats samples can be increased in size or irradiated under stress.	Temperature not controlled or monitored, sample exposure never exceeds Hanford reactors.
2C at KE	Filler layer 105-KE	~350 samples .426 x 4" long charged into graphite boats	ambient filler block temperature 500 to 600° C.	Same as for Y at C. Slightly higher rate of exposure accumulation than the Y at C.	Same as Y at C.
IP-22	Process tube channel 105-B	Eight samples .426" diameter x 4" long	controlled 200, 250, 300 & 350° C.	Accurate temperature control and monitoring, provides information in temperature range for which there is only limited data.	Limited number of samples; sample size limited.
GEH-9	L-42 position in MTR.	Four 1/8" thick wafers 1" in diameter	controlled between 650 and 1100° C.	Accurate temperature control and monitoring at high temperatures. Accelerated exposure accumulation.	Sample size and number restricted. Position "shared" with KAPL-37. Flux not equivalent to Hanford.
Shim Rod Conversion	L-48 position in MTR.	Same as GEH-9 above.	Same as GEH-9	Same as GEH-9. Exclusive use of the position.	Same as GEH-9 except not yet operating or proven. One-cycle necessary for flux calibration.
GEH-13	ETR E-5 and N-14 position	Eight .426 diam. x 4" long samples	Temperature monitored but not controlled 500 to 1700° C.	Very high temperature with accelerated exposure accumulation. Sample size and capacity greater than GEH-9. Does not compete with other experiments.	At least 1 cycle in each position required for flux calibration. Flux not equivalent to Hanford. Experiment not operating or fully proven.

UNCLASSIFIED

FIGURE I
SCHEDULE OF GRAPHITE IRRADIATIONS

1958				1959												1960			
S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A

FACILITY:

2B at KE

1	KC, CSF, CSGBF, TSGBF, SGHF, 7000 to 11000
2	SP1, SP2, SP6, VT, RO, RC, RS, RT, CSF, TSGBF, 2000
3	HTH Coated J2,3,4

2B at KW

2	GL10, GL11, CO, SV, SP7, SP9
1	SP10, TSGBF 1400

Y at C

1	KC, CSF, CSGBF, TSGBF, SGHF, 7100
2	GL6, GL7, GL8, RO, RC, RS, RT, OO, 2000
3	SP5, SP6, CSF, TSGBF, 3800
4	VT, D57, 3000
5	GL6, GL7, GL8, SP1, SP5, SP6, 1700
	OO, RT, RC, RO, RS, CSF, TSGBF

IP-22

CSF	2000
-----	------

2C at KE

1	GL 10, GL 11, CO, SV, SP7, 1600
2	D58, SP9, SP10, CSF, TSGBF, 1600
4	KC STRESSED SAMPLES (3) STRESSED SAMPLES
	ENCAPSULATED SAMPLES FOR OXIDATION
	EFFECT STUDY 1600
5	COATED GRAPHITES 1000

NOTE: Numbers opposite sample code indicate total accumulated exposure in MWD/AT.

DECLASSIFIED

FIGURE I
SCHEDULE OF GRAPHITE IRRADIATIONS
(Continued)

	1958		1959										1960					
FACILITY:	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
MTR L-42	(1) TSGBF & CSF		(2) TSGBF & CSF		KAPL - 37										(3) 105-N GRAPHITE			
ETR E-5	(1) TSGBF & CSF		(2) KC & NEW COKE		(3) KC & CSF		(4) ALTERNATE NEW COKES		(5) STRESSED KC		(6) 105-N GRAPHITE							
ETR N-14	(1) TSGBF & CSF		(2) KC & NEW COKE				(3) ALTERNATE NEW COKES		(4) STRESSED TSGBF		(5) 105-N GRAPHITE							
MTR L-48	(1) TSGBF & CSF		(2) KC & NEW COKE				(3) ALTERNATE NEW COKES		(4) 105-N GRAPHITE									

NOTE: MTR & ETR schedules assume no unforeseen difficulties will arise in getting experiments started and facilities calibrated.

DECLASSIFIED

DATE

FILMED

8/24/94

END