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SUMMARY OF INFORMATION FOR U.K.
INFORMATION REQUEST ON GAEA FLUX MORTIC

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11. JS McMahon - WM Harty
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5 pages.

December 4, 1958

R. L. Dickeman
Manager, Process and Reactor Development

SUMMARY OF INFORMATION FOR U. K.
INFORMATION REQUEST ON GAMMA FLUX MONITOR

- References: 1. Letter, H. E. Parker to O. H. Greager, subject as above, dated October 17, 1958.
2. Your letter to H. E. Parker, subject as above, dated October 29, 1958.

Summarized herein is our available information on the subject, "Reactor Gamma Flux Monitors." Apparently, a misunderstanding exists between the U.K. representatives and the related information presented by Dr. Nilson at the Argonne meeting July 24 and 25th. Dr. Nilson's reference at the US/UK meeting was to the use of gamma-compensated neutron detection chambers at Hanford. Such chambers have been designed and used in one old reactor for a short period as a prototype for a detector for the octant monitor system. No gamma compensated chambers are in any of the reactors at present. Under development is a neutron flux indicating system which will operate in the intermediate range (10^{-7} to 10^{-1} full power) and will use commercially available gamma compensated ion chambers. These will be used to provide signals for reactor period meters.

We at Hanford do not have operating experience with gamma flux monitors as such or with extensive in core neutron flux monitors. Characteristics of systems under development are given for information as well as current information on our octant system.

I. Octant System

Under development for the old reactors and installed in the three new reactors is an octant monitor system. The detectors are located in each of the eight corners of the reactors in the thermal shielding. Ultimately, the system will provide high flux trip as well as their present function of continuous flux monitoring.

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I. Octant System (Cont'd)

The basic operation is the same as for any ion current chamber; the presentation of the information at the console is the average current of all the currents from the eight chambers, and the deviation of each chamber current from the average is also indicated.

The components for each system are as follows:

Chambers: Commerical GE Mark II boron coated neutron detector
Diameter 3", length with cap 14", sensitivity = 6×10^{-15}
amp/nvt.

Thimble: Aluminum. Adequate length to project 2 to 4 inches into
graphite stack. Each thimble is long enough to permit
✓ 9 inches of chamber movement.

Power Supplies: High voltage power is a dual unit with regulated and
adjustable voltage over a 300-500 volt D.C. range;
normal current rating is 10 milliamperes. The secondary
supply is a dry rectifier type of the same capacity.

Monitors: Monitors are indicating, current-sensitive relays with
adjustable high alarm and/or reactor safety trip contacts.
The current ranges may be varied between 50 and 1000
microamperes. The trips can be adjusted to permit trips
from 0 to 100% of meter range.

The following prints for the K reactors are available which describe the
system and instrumentation.

H-1-22900 - Octant Monitoring System Arrangement.

H-1-22903 - Octant Monitoring Control Panel Arrangement and Circuit
Diagram.

H-1-22904 - Galvanometer Variable Potentiometer, Assembly and Details.

II. In-Core Flux Monitors

Gamma flux monitors are not currently in use in our reactors. However,
our recent in-core neutron flux monitor developments have included a gamma
flux monitor system which employs air ionization chambers. At or near reactor
operating equilibrium gamma flux is nearly proportional to the neutron flux.

Other approaches to in-core neutron flux monitoring problem have been:

- 1) Fission heating devices with temperature differential outputs.
- 2) Fission chambers.
- 3) Wire traverse systems with the neutron flux profile determined by
monitoring the gamma in activities along the withdrawn activity.

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II. In-Core Flux Monitors (Cont'd)

With reference to the U.K. inquiry, we are supplying the following information relative to our gamma flux monitor developments. We are still in the development phase of this system, so we cannot supply operating details. Our source of operating information and details has been the Savannah River Operation. With their permission and the cooperation of the respective AEC Operations, we have modified the system to meet our criteria and specifications.

The following data are classified secret and reflects SRO and HAP0 reactor neutron and gamma flux levels, reactor-in-pile component quantities and associated data.

A. HAP0 System Criteria

1. Detector operating neutron flux range $\sim 2 \times 10^{12}$ to 2×10^{14} nv
2. Detector operating gamma flux range $\sim 10^6$ to 10^8 R/Hr.
3. Detector operating output current range ~ 10 to 60 μ A.
4. Detector and leadwire ambient temperature $< 50^\circ$ C
5. Number of detectors per system* 25
* Number of detectors per HAP0 reactor
6. Detector locations** in-core
** 5 front to rear water cooled channels
5 detectors per channel detector location
1/6, 1/3, 1/2, 2/3, 5/6 of active core length
7. Detector readout system*** Continuous indication
*** Individual detector indicators with Hi-Lo adjustable trips.
Provisions for ratio recordings.

B. SRO Operating System Data

1. Detector operating neutron flux range $\sim 5 \times 10^{12}$ to 5×10^{14} n
2. Detector operating gamma flux range $\sim 10^7$ to 10^9 R/Hr.
3. Detector operating output current range ~ 20 to 80 μ A.
4. Detector and leadwire temperatures $< 105^\circ$ C
5. Number of detectors in service* 109
* Total all reactors as of 6-15-58

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II. In-Core Flux Monitors (Cont'd)

B. (Cont'd)

6. Detector locations** in-core
** 7 vertical moderator cooled channels
3 detectors per channel
(detector location 1/3, 1/2, 2/3 of active core height).
7. Detector readout system*** Continuous indication
*** Individual detector indicators with Hi-Lo adjustable trips.
Provisions for ratio output indications.

C. HAPO and SRO Detector Data

1. Detector outside diameter	1/2"
2. Detector length	2 1/8"
3. Detector chamber active area	1" length x 0.369" av. diameter x 0.030" air gap
4. Detector fill gas	Air
5. Detector fill pressure	1 atmosphere
6. Detector lead cable	Triax
7. Detector lead cable outside diameter	5/16"
8. Detector operating voltage	600 v.

The preceding information was classified secret. The remaining information is unclassified. The following S.R.O. detector and system prints are listed here for reference.

S.R.O. Gamma Monitor System Print Nos.

85-1-501	85-1-460	85-1-463
85-1-472	85-1-461	85-1-471
85-1-469	85-1-462	85-1-473
85-1-466	85-1-465	85-1-470
85-1-468		

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C. HAPO AND SRO Detector Data (Cont'd)

HAPO modified SRO Gamma Monitor System prints have not been assigned print numbers. HAPO prints and system modifications are not yet complete.

There exist no data at present at HAPO with regards to the gamma flux monitor detectors. This detector material list will provide the U.K. with the necessary information to evaluate and estimate the intensity and source of gammas emitted by the detector. These data can best be calculated and evaluated by U.K. personnel utilizing their reactor neutron flux and operating conditions.

D. SRO-HAPO Detector Materials

1. Detector shell and collector aluminum	2S or 1100
2. Detector collector supporting insulators	Sapphire
3. Detector lead cable (Triax)*	Aluminum 2S or 1100
* Aluminum sheath	
" shield	
" collector	
4. Detector lead cable (insulation)	Refrasil (refractory silica)
5. Detector chamber welds
(Welds by heliarc process)	Aluminum

As far as the proportion of prompt to delayed gammas arising from U-235 fission, we are using the current work by F. C. Maienschein, reported in ORNL-2609. The delayed gammas from other pile sources depend on the particular pile materials and the neutron absorption rates in those materials.

R. Nilson
A. G. Dunbar

Reactor Physics
Research and Engineering
IRRADIATION PROCESSING DEPARTMENT

R Nilson:AG-Dunbar:esk

DATE

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