SECRET 717149 1090

ATOMIC ENERGY COMMISSION
CHICAGO OPERATIONS OFFICE

REPOSITORY Oak Ridge Operations Records Holding Area
COLLECTION Documents 1944-94
Bldg. 2714-H
BOX No. 4NN-326-87-8 34 of 45
FOLDER Medicine, Health & Safety July 1, '53 - June 30, '54

CLASSIFICATION CANCELLED
~~OR CHANGED TO~~
BY AUTHORITY OF DOC
BY H. [illegible] DATE 9-8-71

SUBJECT: MEDICINE, HEALTH, AND SAFETY
3-2 - Radiation - Hazards and Control

NOTICE.
DOCUMENTS REMOVED FROM THIS FOLDER MUST BEAR THE STAMP BELOW-INITIALED AND DATED BY THE CUSTODIAN.

BEST COPY AVAILABLE

SPECIAL REREVIEW
FINAL DETERMINATION
UNCLASSIFIED
By: [illegible]
Date: 8/14/86

DATE: July 1, 1953 through June 30, 1954

CONTENTS MUST NOT BE REMOVED

~~RESTRICTED DATA~~
~~This document contains restricted data as defined in the Atomic Energy Act of 1946. Its transmittal or the disclosure of its contents in any manner to an unauthorized person is prohibited.~~

RETURN TO: Area Manager
Lockland Area Office

Jan. 55

SECRET

AEC-CH FORM 146 (11/15/48)

1108396

FN-205 (3-50)

GENERAL ELECTRIC COMPANY

COPY for ~~SECRET~~

June 30, 1954

Dr. C. R. Russell (2)
U.S. Atomic Energy Commission
1901 Constitution Avenue, N.W.
WASHINGTON 25, D.C.

Subject: TRA-2 CRITICAL EXPERIMENT HAZARDS

Dear Dr. Russell:

Following the presentation to the Advisory Committee on Reactor Safeguards of material pertaining to hazards of operation of critical experiments with the TRA-2 Reactor, it was requested that further information be documented concerning two items, as follows:

1. Description of methods being adopted for control of speed of filling and upper level of water in the reactor tank.

2. Comparison of distances from radioactive cloud for a 300-roentgen dose versus energy release at origin of cloud as calculated by Aircraft Nuclear Propulsion Department methods outlined in APEX-155 and by a simplified formula which has been used for approximation by the Advisory Committee on Reactor Safeguards.

These subjects are here presented in order.

Water Control

The water system in general is described in APEX-155, p. 28 ff. The two storage tanks have capacities of 1800 gallons and 1200 gallons. The 200-gpm pump is connected to the 1800-gallon tank only. It can therefore deliver sufficient water to raise the water level in the reactor tank to 121 cm with no submerged reflector or to 127 cm with a submerged beryllium reflector. The 20-gpm pump is connected to the 1200-gallon tank and can deliver sufficient water for anticipated operating requirements.

In addition, capacity probes provide interlocks for control of the water pumps. When the water is at a height of 121 cm (no submerged reflector), the 200-gpm pump is shut off, and the 20-gpm pump can be

~~RESTRICTED DATA~~

~~This document contains restricted data as defined in the Atomic Energy Act of 1946 or the disclosure of its contents in any manner to an unauthorized person is prohibited.~~

1108397

~~SECRET~~

operated. The 20-gpm pump will not operate at levels below 121 cm, thus ensuring that all water pumped at levels below 121 cm is delivered from the 1800-gallon tank. At a level of 172 cm, a capacity probe shuts off the 20-gpm pump. Each pump is operated by manually holding closed a push-button switch.

A vertical standpipe is installed in the system to prevent overfilling of the water tank in the event of failure of the capacity probes to control the water level. It consists of two coaxial pipes. If the level exceeds 172 cm, water will flow over the top and down through the inner pipe back to the tanks. The inner pipe will pass 20 gpm at a differential head of 0.5 cm. If the rate of filling were to exceed 80-100 gpm, the level would rise to 176 cm, and water would begin to flow over the top of the outer pipe onto the floor of the room. At a difference in level of about 5 cm, the outer pipe will pass 200 gpm. This allows an assured safety margin of 18 cm between maximum water height and the top of the fuel tubes even if all interlocks fail.

Performance tests have been made on the capacitance probes. Cycling 10,000 times under simulated operational conditions resulted in no failure. Also, at more than 10 times operating water pressure, the probes remained leak-tight.

Radioactive Cloud Dosages

The formula $D = 0.007 \sqrt[3]{\text{kw-sec}}$, where D is the distance in miles from the cloud origin at which a 300-roentgen dose is received, and the kw-sec represents the energy release associated with the cloud formation, has been used for calculating approximate exclusion radii by the Advisory Committee on Reactor Safeguards. The formulae and methods described in APEX-155 have also been used to calculate values of D versus kw-sec for doses of 300 R resulting from gammas alone and from gammas plus betas at two different stack heights. The attached graph makes possible a comparison of results derived by the two methods of calculation. It is apparent from a comparison of values calculated under equivalent conditions ($\beta + \gamma$ dose at h = 0) that the ANP formulae are realistic.

In addition to the above information requested by the Advisory Committee on Reactor Safeguards, the possibility of aluminum melting during a reactor excursion has been given considerable study by the Nuclear Analysis Unit. The most probable mechanism for producing melting is convective heat transfer from the flowing Teflon vapor.

If it is assumed that the moderator side of the wall is a perfect insulator, and that Teflon vapor is flowing past the inner side at a velocity of 2000 ft/sec and at a temperature of 950°C, the time required to raise the Teflon side of the aluminum wall to its melting point is of the order of 200-300 milliseconds.

In an actual TR-2 runaway, the following conditions would exist:

1. The Teflon vapor would flow for 5-10 milliseconds.
2. The average vapor temperature would be approximately 850°C.
3. The aluminum wall would not be insulated on one side, but would be cooled by the water moderator.

It is therefore concluded that the aluminum would not melt during a runaway of the types referred to in APEX-155 as "maximum accident" and "probable maximum sabotage".

Very truly yours,

ORIGINAL SIGNED BY
J. A. HUNTER
J. A. Hunter
Nuclear Experimental Unit
ANP DEPARTMENT

JAH:vml - 0101

Attach. (1) Unclassified graph

cc: AR Frithsen
JA Hunter
MC Leverett
BJ Sevold
EM Velten

~~RESTRICTED DATA~~

~~This document contains ... of the ... unauthorized person is prohibited~~

1108399

~~SECRET~~

GENERAL ELECTRIC COMPANY

~~SECURITY INFORMATION~~

AIRCRAFT NUCLEAR PROPULSION PROJECT

CINCINNATI 15, OHIO . . . . . TELEPHONE VALLEY 7400

December 4, 1953

Major A. R. Frithsen, Chief
Technical Branch
Atomic Energy Commission
CINCINNATI 15, OHIO

Dear Major Frithsen:

In reference to your letter of 3/16/53 (XD-53-3-8) concerning what might be a significant hazard in the operation of the R-1 Mockup Reactor, the requested analysis has now been completed. It will be presented in detail in a consolidated hazards report to be submitted prior to initial operation of the reactor.

Briefly, the analysis shows that if all the fuel sheets slipped away from the stainless steel plates which normally enclose them, and dropped twelve inches, the loss of one-third of the steel from the active core would form a reactor which would be nine percent overcritical if it had been just critical before slippage occurred. Any fuel distribution other than normal within the normal core boundaries would decrease the reactivity.

The possibility of a runaway due to fuel slippage will be removed by plugging the fuel channels at the bottom of the fuel elements with horizontal metal plates. A negligible amount of fuel will be able to pass the plates, but if water accidentally enters the fuel channels, it will flow out.

Yours truly,

M. C. Leverett

M. C. Leverett
Manager - Engineering
ANP Department
P.O. Box 132

MCL:JAH:vrm

~~RESTRICTED DATA~~

~~THIS DOCUMENT CONTAINS RESTRICTED DATA AS DEFINED IN THE ATOMIC ENERGY ACT OF 1954. INSPECTION OR DISCLOSURE OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED.~~

~~SECRET~~

1108400