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ADDENDUM TO IDO-28506

GCRE-I HAZARD SUMMARY REPORT

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MARCH 1959

Prepared by the Military Projects Division

AEROJET-GENERAL NUCLEONICS

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INTRODUCTION

This addendum has been prepared to answer questions raised by the Reactor Hazards Evaluation Branch as transmitted in a letter dated 4 March 1959 from V. V. Hendrix to A. T. Biehl. This addendum supplements the GCRE-I Hazard Summary Report (IDO-28506) in the following areas: geometry and operation of the steam cooling system and the reactor coolant by-pass and by-pass valving; the means by which by-passed circuits are prevented from remaining unintentionally disabled; design and details of procedure for core flooding operations.

1. Steam Cooling System

This is the "last resort" cooling system. It is used only when the reactor is shutdown and generally only as outlined in Section D of ANSOP 5717. Its use in conjunction with reactor flooding is authorized in ANSOP 5718. In this case, steam cooling is permitted during the portion of the flooding operation where the introduction of steam will not force water up into the core proper. In addition, the water level in the lower plenum is maintained at a low enough point to accommodate the water displaced from the steam line without raising the water to the lower tube sheet. This conservation increases the time required for flooding but is felt to be a safe method of controlling the reactivity addition in this operation.

The schematic arrangement of the steam cooling system and main control valves is shown on Figure 1. Figure 2 shows the details of the piping arrangement under the lower plenum.

2. Reactor Coolant By-Pass Loop

This is an 8 in. line which by-passes the reactor from the outlet side of the fired heater to the inlet side of the gas-to-water heat exchanger. Both terminations of the line are on the compressor side of the main coolant loop block valves as shown in Figure 3. Flow through the by-pass loop is controlled by a single manually operated valve in the heater pit (GNL-V-54).

This piping is designated as Class D (Type 347 Stainless steel, schedule 80 seamless butt-welded fabrication) and has been hydrostatically and leak tested (see Section MS-1, Process & Utility Piping Specifications, Invitation No. AT(10-1)-945). The valve is a 900 lb, type 347 stainless steel gate valve with double packing, butt-welded into the line.

The control valve in this loop is normally padlocked closed and will be operated normally only when the reactor is shutdown. Any situation requiring by-pass coolant flow during reactor operation will be covered by a special procedure under ANSOP Section 9.

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3. Low Flow Scram

Flow element 101, located on the main compressor discharge as shown in Figure 3, is a pressure and temperature compensated mass flow meter. It is instrumented to sound an annunciator at 95% of nominal flow, initiate an automatic setback at 90% of nominal flow, and to initiate a full scram at 85% of nominal flow (see ANSOP 5802). These alarm points are adjustable from a ganged control on the console and are set in step 2 of ANSOP 5702, Reactor Start-up.

In the event that flow through the reactor proper is different from the compressor discharge flow (reactor by-pass open), the reactor is protected by temperature instrumentation. Four thermocouples are located in the exit gas line (TI-103 on Figure 3). This instrument sounds an annunciator at 1220°F, initiates a setback at 1240°F, and initiates a scram at 1260°F. This latter temperature corresponds to a calculated maximum hot spot fuel element temperature less than 1700°F at full power and full flow.

In addition, the mixed mean outlet gas temperature of each fuel element is monitored and an alarm sounds if this temperature reaches 1240°F for any fuel element. ANSOP 5844 requires a manual setback if the temperature reaches 1300°F or if the annunciator cannot be cleared in 15 minutes. The 1240°F is within 20°F of the calculated outlet temperature from the hottest element (E-5) at full flow (1390 lb/hr) and full power (46 Kw). Thus any decrease in flow would sound the annunciator almost immediately.

4. Scram Circuits

ANTS-105 outlines the basic limitations covering the by-passing of scram circuits. The critical circuits (flow, temperature and power) may never be by-passed or disabled according to this standard. In addition, no ready means exists for effecting such disablement, i.e., no keyed switch or equivalent.

ANSOP 5711 provides the administrative controls for application of "jumpers". This procedure is written to prevent any but carefully engineered and studied permanent wiring modifications. Section C-5 of this procedure implements the requirements of ANTS-105 and forbids deactivation of the critical scram and setback circuits.

ANSOP 5703, Section 5-a, requires that whenever the annunciator flasher panel is activated for a scram or setback condition, a manual scram (or setback) shall be initiated by the console operator, regardless of what has occurred in the automatic circuitry. As pointed out in ANSOP 5803, such circuits are clearly identified on the annunciator panel with distinctive red (for scram) and yellow (for setback) illuminated panels. ANSOP 5803 was not included in the original issue of IDO-28506; copies are attached to this addendum.

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5. Flooding Operation

The flooding operation is detailed in ANSOP 5718. Figure 1 shows the piping and valve arrangement with equipment identified as called out in the procedure.

ANSOP 5718 as presented in IDO-28506 requires revision as follows to be correct:

Page 3, item 22, change EP 252 to EP 253.

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1. GCRE-I
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(REFER TO ANSOP 5718)

FIG 1.

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EQPT NO.	DESCRIPTION	NORMAL OPERATION	FLOODING PHASE I	FLOODING PHASE II	FLOODING PHASE III
WP-V-13	MANUAL VALVE	OPEN	CLOSED	CLOSED	CLOSED
WP-V-21	MANUAL VALVE	CLOSED (L)*	CLOSED (L)	CLOSED (L)	CLOSED (L)
WP-V-19	MANUAL VALVE	CLOSED (L)	CLOSED (L)	OPEN	CLOSED (L)
WP-V-20	NEEDLE VALVE SET FOR 1 GPM	SET (L)	SET (L)	SET (L)	SET (L)
WP-V-22	MANUAL VALVE	CLOSED (L)	OPEN	OPEN	CLOSED (L)
WD-V-21	MANUAL VALVE	CLOSED (L)	OPEN	CLOSED (L)	CLOSED (L)
WP-V-15	MANUAL VALVE	OPEN	CLOSED	CLOSED	CLOSED
WP-MV 205	REMOTE OP. VALVE	CLOSED	CLOSED	CLOSED	CLOSED
S-MV 201	REMOTE OP. VALVE	CLOSED	CLOSED	CLOSED	CLOSED
WD-V-19	MANUAL VALVE	CLOSED	OPEN	CLOSED	CLOSED
CS-V-10	MANUAL VALVE	CLOSED	OPEN	CLOSED	CLOSED
CS-V-7	MANUAL VALVE	CLOSED	CLOSED	CLOSED	CLOSED
BNL-V 49	MANUAL VALVE	CLOSED (L)	CLOSED (L)	CLOSED (L)	OPEN
EP 271	WATER HEATER	OUT OF SERV.	IN SERVICE	IN SERVICE	OUT OF SERV.
FI-205	FLOW METER	OUT OF SERV.	IN SERVICE	IN SERVICE	OUT OF SERV.
EP-253	CAL. FLDG. TANK	OUT OF SERV.	IN SERVICE	OUT OF SERV.	OUT OF SERV.
S-1	SPOOL PIECE	REMOVED	INSTALLED	REMOVED	REMOVED
RO	FLOW RESTR. ORF.	OUT OF SERV.	OUT OF SERV.	IN SERVICE	OUT OF SERV.
TI 203	TEMP. INDICATOR	OUT OF SERV.	IN SERVICE	IN SERVICE	OUT OF SERV.
LI 102	LEVEL INDICATOR	IN SERVICE	IN SERVICE	IN SERVICE	IN SERVICE
	*(L) PADLOCKED				

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REACTOR OUTLET PIPING

FIG. 2

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MAIN COOLANT LOOP REACTOR BYPASS

FIG. 3.

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ANSOP NO. 5803

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STANDARD OPERATING PROCEDURE GAS-COOLED REACTOR EXPERIMENT-I

PROCEDURE SECTION: 5 REACTOR OPERATION

TITLE: OPERATION OF ANNUNCIATOR SYSTEM

SCOPE

This procedure outlines the rules to be followed in the operation of the annunciator system. The mechanics of operation are described in ANSOP 5703 - Normal Operation.

The annunciators are divided into "systems" for priority handling and into categories indicating degree of severity. Annunciator classes are defined in ANTS 106. ANSOP 5802 - Scram, Setback and Annunciator circuit schedule shows the category, class and system for each annunciator.

PROCEDURE

1. Annunciator Categories

Annunciators are divided into the following categories, listed from highest to lowest:

- a. Red (R) - Scram condition, execute ABLE.
- b. Yellow (Y) - Setback condition, execute CHARLIE.
- c. Red Stripe (RS) - Incipient scram condition, correct in five minutes or execute BAKER.
- d. Yellow Stripe (YS) - Incipient setback condition, correct in fifteen minutes or execute CHARLIE.
- e. Blue Stripe (B) - Unsafe for prolonged continued operation, correct in four hours or shutdown.
- f. White (W) - Information only.

2. Annunciator Systems

The annunciators are divided into systems as follows:

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a. Control System (System 1)

<u>Category</u>	<u>Number</u>	<u>Title</u>
R	5805	Power Failure - Scram
R	5809	Seismometer - Scram
R	5816	Safety Rods Low Pressure - Scram
RS	5833	Safety Rods Low Pressure
RS	5872	Nuclear Instrument Failure
RS	5877	Water in Rods
YS	5840	Emergency Power Failure
W	5854	Instrument Air-Low Pressure

b. Gas Temperature System (System 2)

<u>Category</u>	<u>Number</u>	<u>Title</u>
R	5807	High Temperature - Scram
Y	5821	High Temperature - Setback
RS	5858	High Temperature
YS	5870	E-101 Gas Temperature - High
YS	5859	WD Flow - Low
YS	5860	WD Temperature - High
YS	5844	Fuel Element Temperature - High
B	5866	WD Surge Drum Level - Low
B	5869	WD Surge Drum Pressure - Low
W	5861	WC Temperature - High
W	5862	WC Pressure - Low
W	5838	CT-301 Basin - Low
W	5826	Heater Burner Failure
W	5827	Heater Fuel Oil Pressure - Low
W	5828	Heater Fuel Oil Storage Level - Low
W	5832	AU Pressure - Low

c. Power Level System (System 3)

<u>Category</u>	<u>Number</u>	<u>Title</u>
R	5808	Power Level High - Scram
R	5812	Log-N High - Scram
Y	5823	Power Level High - Setback

d. Period System (System 4)

<u>Category</u>	<u>Number</u>	<u>Title</u>
R	5813	Period Short - Scram
R	5814	Period Short - Scram
Y	5820	Period Short - Setback

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e. Gas Flow System (System 5)

<u>Category</u>	<u>Number</u>	<u>Title</u>
R	5806	Low Flow - Scram
R	5873	Water in Main Loop
Y	5822	Low Flow - Setback
RS	5845	Compressor Speed - Low
YS	5855	Low Flow
B	5849	Make-up Flow - High
B	5846	Lube Oil Temperature - High
B	5850	Loop Humidity - High
B	5856	High Pressure
B	5857	Low Pressure
B	5851	N ₂ Storage, Low Pressure
W	5847	Lube Oil Pressure - Low
W	5848	Compressor Reservoirs - Low Levels

f. Shutdown Cooling (System 6)

<u>Category</u>	<u>Number</u>	<u>Title</u>
RS	5843	Blowdown N ₂ Pressure - Low
-	5841	Shutdown Cooling Loop Flow - Low
-	5842	Shutdown Cooling Loop Temperature - High

g. Personnel Protection System (System 7)

<u>Category</u>	<u>Number</u>	<u>Title</u>
R	5810	Reactor Room Doors - Scram
R	5811	Run - Safe System - Scram
RS	5879	FPM High Activity
B	5863	Waste N ₂ Storage Level - High
B	5864	Reactor Pool Level - Low
B	5871	RAMS - High
W	5874	Thermocouple Harness Pressure - High or Low
W	5867	D-203 Level - High
W	5868	D-202 Level - High
W	5878	Compressor Seal Water Pressure - Low

h. Miscellaneous (System 8)

<u>Category</u>	<u>Number</u>	<u>Title</u>
W	5830	WU Low Pressure
W	5831	WU Storage Level - High
W	5839	CT-301 Basin Level - High

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<u>Category</u>	<u>Number</u>	<u>Title</u>
W	5853	O ₂ Storage Pressure - Low
W	5865	Reactor Pool Level - High
W	5834	Boiler Flame Failure
W	5835	Boiler Oil Tank Level - High
W	5836	WP Demineralizer Conductivity - High
W	5837	Raw Water Demineralizer Conductivity - High
W	5852	Loop O ₂ - High
W	5875	Inlet Duct Temperature - High
W	5876	Outlet Duct Temperature - High
W	5829	WU Storage Level - Low

3. Operating Rules

- a. Within a given system, execution of a given emergency procedure will be discontinued if an annunciator sounds indicating a tripped condition on a higher category annunciator in the same system. In such a case, the emergency procedure for the new annunciator will be initiated immediately.
- b. If simultaneous annunciators occur in more than one system, the following rules apply:
 - (1) Any system (1), or (2) or (6) annunciator has priority over any annunciator of equal or lower category in any other system. The procedure for the priority annunciator shall be executed first; the procedures for lower priority annunciators shall be executed as time permits.
 - (2) Procedures for annunciators in systems (1), or (2) or (6) shall be executed simultaneously, regardless of category or order of receipt.

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