Post Operating Exam Comment #1

Scenario 2 Critical task 3 states:

After all RPV level instruments flash (level unknown), inject into the RPV with all available sources until one of the conditions in C-4, Note 7 is met.

1. Safety Significance
   Prevent fuel damage by establishing adequate core cooling

2. Cues
   Procedural compliance
   Loss of all RPV level indications

3. Measured by
   Observation-Indications that the Main Steam Lines are flooded
   are listed in C-4 Note 7

4. Feedback
   MSRV tail pipe temperature
   MSRV acoustic monitor
   RPV Pressure trend

This Critical Task is **not met** if the Crew fails to continue to raise level and maintain pressure on the vessel.

Crew Performance:

One of the Crews did not inject into the RPV with all available sources until one of the conditions in C-4, Note 7 is met.

Bases for Post Exam Comment:

EOI step C4-25 states: Flood the RPV to the elevation of the main steam lines with the following. It does not say to use all available sources.

EOIPM Section 0-V-J Discussion of step C4-25 states:
aligned to flood the RPV and establish core cooling by submergence. The list of flooding methods includes all sources capable of injecting into the RPV, including the "alternate injection subsystems" defined in EOIPM Section 0-I-C. Any or all of the listed methods may be used as necessary to flood the RPV to the elevation of the main steam lines.

The Facility recommends rewording the critical task as follows:
After all RPV level instruments flash (level unknown), flood the RPV with any or all of the listed methods to the elevation of the main steam lines.

1. Safety Significance
   Prevent fuel damage by establishing adequate core cooling

2. Cues
   Procedural compliance
   Loss of all RPV level indications

3. Measured by
   Observation-Indications that the Main Steam Lines are flooded are listed in C-4 Note 7

4. Feedback
   MSRV tail pipe temperature
   MSRV acoustic monitor
   RPV Pressure trend

This Critical Task is **not met** if the Crew fails to continue to raise level and maintain pressure on the vessel.

1.0 CONTINGENCY # 4, RPV FLOODING BASES (continued)

C4-25

ISOLATE ANY of the following NOT needed for RPV injection:
- Main steam lines
- Main steam line drains
- HPCI
- RCIC

C4-24

CAUTION

#2 Pump NPSH and Vortex Limits

#3 Elevated suppr chmbr press may trip RCIC

#6 HPCI or RCIC suction temp above 140°F

FLOOD the RPV to the elevation of the main steam lines with the following:

INJ SOURCE	APPX	INJ PRESS
CNDS and FW	5A	1210 psig
CRD	5B	1640 psig
RCIC with CST suction if available	5C	1200 psig
HPCI with CST suction if available	5D	1200 psig
CNDS	6D, 6E	480 psig
CS	6A	330 psig
LPCI	6B, 6C	320 psig
CS	6D, 6E	330 psig
Stby coolant	7D	160 psig
RHR crosstie to other units	7C	320 psig
Fire Protection system	7K	150 psig
CNDS transfer pumps to RHR and CS	7A	110 psig
RHR drain pumps	7E, 7F	50 psig
PSC head tank pumps	7G	30 psig
RCIC (aux boiler steam) with CST suction if available	7H	1200 psig
RCIC manual start	EDMG-24 APPX B	1200 psig
HPCI (aux boiler steam) with CST suction if available	7J	780 psig
SLC (boron tank)	7B	1450 psig
SLC (test tank)	7B	1450 psig
Portable pump	EDMG-24 APPX E	150 psig

C4-25

1.0 CONTINGENCY # 4, RPV FLOODING BASES (continued)

DISCUSSION : C4-25

Once the MSRVs have been opened to depressurize the RPV, injection sources are aligned to flood the RPV and establish core cooling by submergence. The list of flooding methods includes all sources capable of injecting into the RPV, including the "alternate injection subsystems" defined in EOIPM Section 0-I-C. Any or all of the listed methods may be used as necessary to flood the RPV to the elevation of the main steam lines.

Steam-driven systems may be used, if needed and available, even though RPV water level may eventually exceed the elevation of the steam supply nozzles. While flooding the steam lines of operating systems could result in extensive damage, it is unlikely that RPV water level would actually reach the steam lines while the systems are in use. With the reactor shutdown, the RPV will likely depressurize to below the turbine stall pressures as a result of steam flow through the MSRVs and operation of the steam-driven systems themselves.

If suppression pool water level cannot be maintained above the top of the HPCI exhaust opening, HPCI must be secured, irrespective of whether the core is adequately cooled, in accordance with SP/L of the Primary Containment Control flowchart. Operation with the exhaust exposed would directly pressurize the suppression chamber. No such restriction exists for RCIC operation since the RCIC exhaust flowrate is much smaller and elevated suppression chamber pressure will trip the RCIC turbine before primary containment integrity is challenged.

High RPV water level logic may be defeated as necessary to permit use of available flooding sources. If RPV water level cannot be determined, the inputs to the logic must be considered invalid. Other system operating details are consistent with those listed in Steps RC/L EOI-1.

Post Operating Exam Comment #2

Scenario 3 Critical task 3 states:

During an ATWS, when conditions with Emergency Depressurization required, Terminate and Prevent RPV injection from ECCS and Feedwater until reactor pressure is below the MSCP as directed by US.

1. Safety Significance:
   Prevention of fuel damage due to uncontrolled feeding.

2. Cues:
   Procedural compliance.

3. Measured by:
   Observation - No ECCS injection prior to being less than the MSCP.
   AND
   Observation - Feedwater terminated and prevented until less than the MSCP.

4. Feedback:
   Reactor power trend, power spikes, reactor short period alarms.
   Injection system flow rates into RPV.

This Critical Task is **not met** if the Crew injects too fast and causes power oscillations or APRM downscale clear (>5% power).

Crew Performance:

Crew B did terminate and prevent RPV injection from ECCS and Feedwater until reactor pressure was below the MSCP however; they did momentarily exceed the APRM downscale setpoint of 5% power once RPV injection was reestablished.

Bases for Post Exam Comment:

The following statement was added to the critical task at the request of an NRC examiner during the exam preparation week:
"This Critical Task is **not met** if the Crew injects too fast and causes power oscillations or APRM downscale clear (>5% power)".

The Facility disputes this statement as bases for failing to meet this critical task. The actions required by the critical task and measured against the above listed "Measured by" criteria in the critical task were satisfied by the crew.

In accordance with EOI step C5-25 the Crew started injection in a controlled manner using only the Condensate system and increased flow using the startup bypass (throttle) valve to restore Reactor water level. Once the determination was made that Reactor water level could be restored and maintained above (-) 180 inches the crew was directed by step C5-28 back to C5-14 which was already completed.

The next step, C5-15 states:

IF Reactor power is above 5% or unknown **And** Reactor water level is above (-) 50 inches **Then** go to step C5-5. (Note that the APRMs could be above 5% and no action is required as long as Reactor water level is below (-) 50 inches, see EOIPM section 0-V-K). The Crew recognized that that Reactor power and Reactor water level were rising and injection was stopped prior to exceeding (-) 50 inches. Reactor water level lowered rapidly to approximately (-) 87 inches and the operator resumed injection with condensate. Reactor power momentarily exceeded 5% and Reactor water level reached (-) 50 inches. The conditions for step C5-5 were not meet because with Reactor pressure less than 50 psig above suppression chamber pressure the MSRVs would be closed. The crew immediately secured injection IAW C5-9 and Reactor water level immediately lowered to below (-) 50 inches allowing injection to the Reactor to be resumed IAW C5-10.

The actions of the crew were in accordance with C5 and EOIPM 0-V-K, Contingency #5 Level/Power Control Bases.

Based on C5 and EOIPM 0-V-K there was no Safety Significance to momentarily exceeding 5% power on the APRMs.

The facility recommends removing the statement below from the Critical task.

"This Critical Task is **not met** if the Crew injects too fast and causes power oscillations or APRM downscale clear (>5% power)".

The Critical task could be reworded to include failure criteria as follows.

During an ATWS, when conditions with Emergency Depressurization required, Terminate and Prevent RPV injection from ECCS and Feedwater until reactor pressure is below the MSCP, then restore and maintain Reactor water level above (-) 180 inches.

This Critical task is not met if the crew fails to recognize and take action to secure injection to the Reactor if the conditions of C5-5 or C5-15 are met.

See attached Plots of Reactor Power, Pressure, and Water level.

1.0 CONTINGENCY #5, LEVEL/POWER CONTROL BASES (continued)

DISCUSSION: C5-6

To prevent or mitigate the consequences of any large irregular neutron flux oscillations induced by neutronic/thermal-hydraulic instabilities, RPV water level is lowered sufficiently below the elevation of the feedwater sparger nozzles. This places the feedwater spargers in the steam space providing effective heating of the relatively cold feedwater and eliminating the potential for high core inlet subcooling. For conditions that are susceptible to oscillations, the initiation and growth of oscillations is principally dependent upon the subcooling at the core inlet; the greater the subcooling, the more likely oscillations will commence and increase in magnitude.

If reactor power is at or below the APRM downscale trip setpoint (**A.23**), it is highly unlikely that core bulk boiling boundary would be below that which provides suitable stability margin for operation at high powers and low flows. (A minimum boiling boundary of 4 ft above the bottom of active fuel has been shown to be effective as a stability control because a relatively long two-phase column is required to develop a coupled neutronic/ thermal-hydraulic instability.) Furthermore, flow/density variations would be limited with reactor power this low since the core has a relatively low average void content. Therefore, there is significant stability margin with power at or below the APRM downscale trip setpoint.

1.0 CONTINGENCY #5, LEVEL/POWER CONTROL BASES (continued)

DISCUSSION: C5-10 and C5-11

Twenty-four inches below the lowest nozzle in the feedwater sparger has been selected as the upper bound of the RPV water level control band (**A.82**). This water level is sufficiently low that steam heating of the injected water will be at least 65% to 75% effective (i.e., the temperature of the injected water will be increased to 65% to 75% of its equilibrium value in the steam environment). This water level is sufficiently high that control of RPV water level with feedwater pumps can preclude the MSIV low water level isolation.

RPV water level must drop to this level before RPV injection can be restarted. Since this level will become the upper limit of the RPV water level control band in subsequent steps, space is provided next to step C5-11 to record the level.

1.0 CONTINGENCY #5, LEVEL/POWER CONTROL BASES (continued)

DISCUSSION: C5-25

Injection into the RPV is re-established to maintain adequate core cooling. Irrespective of whether the reactor is shutdown, injection is controlled to make up the mass of steam being rejected through open MSRVs and, if possible, to keep the core submerged. Injection is increased slowly to preclude the possibility of large reactor power excursions due to the rapid injection of relatively cold, unborated water under conditions where the reactor may not be shutdown. The Minimum Steam Cooling RPV Water Level is specified as the lower limit for control of RPV water level to provide the widest possible control band.

The systems listed in this step are the same preferred systems listed earlier in Steps C5-13 and C5-16—those that are relatively easy to align, provide high quality water, and either inject outside the core shroud or inject borated water. When RPV injection is restored or increased under failure-to-scram conditions, injection systems should be aligned and operated in the manner that minimizes the potential for core instabilities and power excursions while still accomplishing the objectives of the EOI ATWS strategies.

- Injection locations should be selected to optimize mixing and preheating of injection flow and minimize the potential for boron removal from the core. Injecting into the downcomer steam space provides effective mixing and preheating, thereby reducing core inlet subcooling and minimizing the potential for core instabilities and power excursions. Injecting into the downcomer region below water level and through the jet pumps provides good mixing of injection and recirculation flows but results in greater core inlet subcooling than injection into the downcomer steam space. Injection paths discharging directly into or over the core region should be used only as a last resort due to the higher potential for boron displacement and cold water induced power excursions.

- Systems providing good flow control capability should be used to avoid large, rapid increases in core flow.

- The injection rate should be increased slowly and only when reactor power is not increasing. (Refer to the definition of "slowly" in EOIPM 0-I-C.)

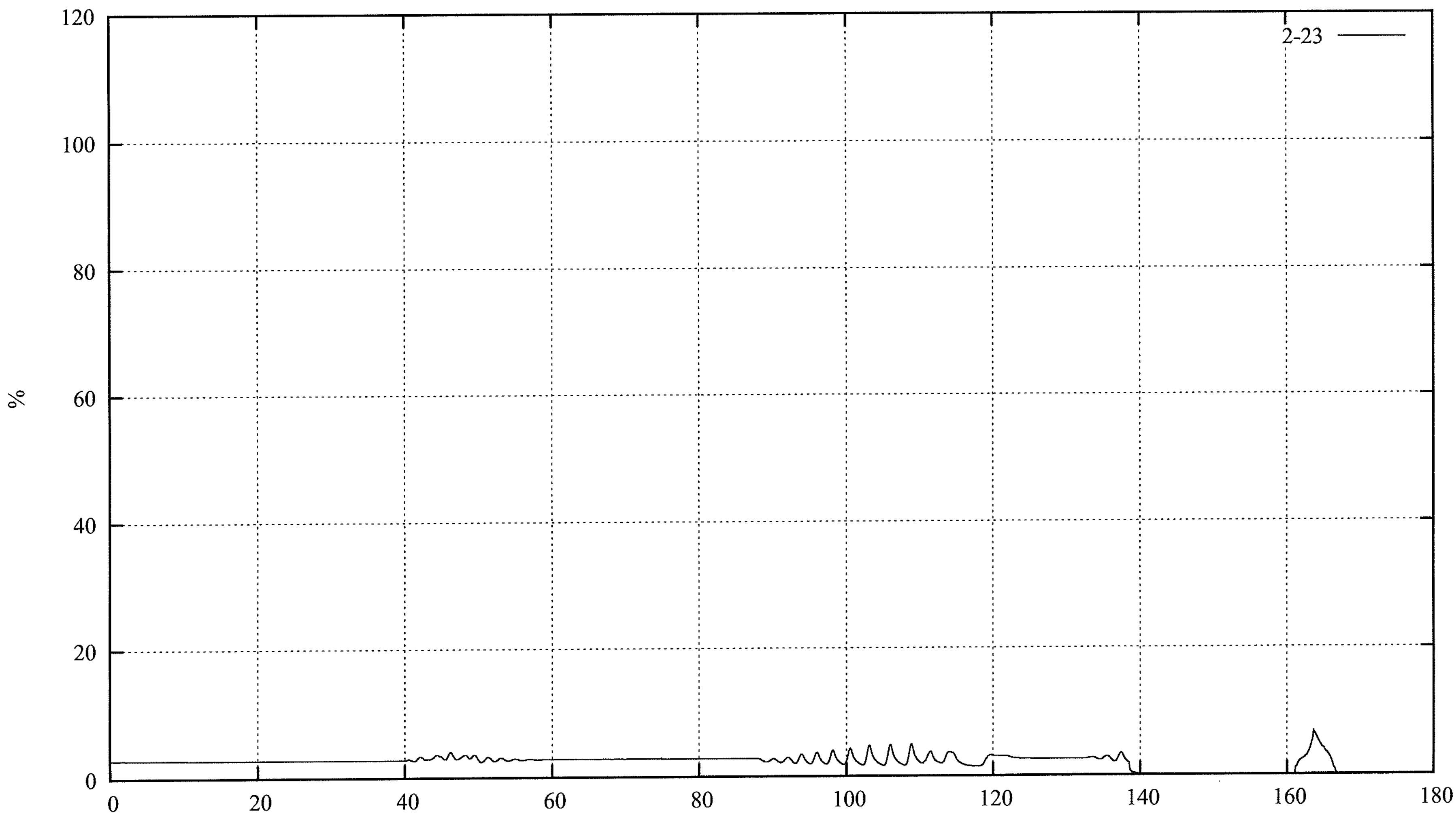
3.0 ABBREVIATIONS, ACRONYMS, AND DEFINITIONS (continued)

TERM/PHRASE	MEANING/DEFINITION * Denotes NRC/C [RIMS L44 900706 802]
Slowly	Perform a specified action in a careful, controlled manner, making incremental adjustments to avoid undesirable consequences that may result from rapid changes in parameter values. Used specifically to identify the need for caution when restoring or increasing RPV injection under failure-to-scram conditions. If a potential for power excursions exists, RPV injection should be increased gradually while monitoring reactor power. If a sustained increase in reactor power is observed, the injection rate should be stabilized until reactor power is no longer increasing. A direction to "slowly increase RPV injection" moderates the rate of change in injection rate but does not itself limit the final steady state flow. No quantitative limit on the rate of change can be defined since the appropriate rate is dependent on the nature of the event and the operating characteristics of available systems. Injection should be increased as slowly as reasonably achievable while still accomplishing the objectives of the PSTG ATWS strategies. Systems providing effective control capability over a wide range of flows permit more gradual changes than those with no throttling capacity. If flow cannot be throttled, options for increasing injection "slowly" may be limited to initiating systems individually at full flow, starting with those of lowest capacity.
SM	Shift Manager
SP/L	Suppression Pool Level Control
SP/T	Suppression Pool Temperature Control
SRM	Source Range Monitor
SRO	Senior Reactor Operator
SRV	Main Safety Relief Valve
SRVTPLL	MSRV Tail Pipe Level Limit
STBY	Standby

Scenario 3 Crew B

1501 NRC Exam - Unit 2 Simulator

X-23 - YUAAPRM1 % APRM 1 POWER [2.77209 : 3e-06 : 6.60201 : 0.086672]



1-X - /usr/tmp/plout.25441 -
2-X - NRC-3B.d - Tue Jan 20 13:48:09 2015

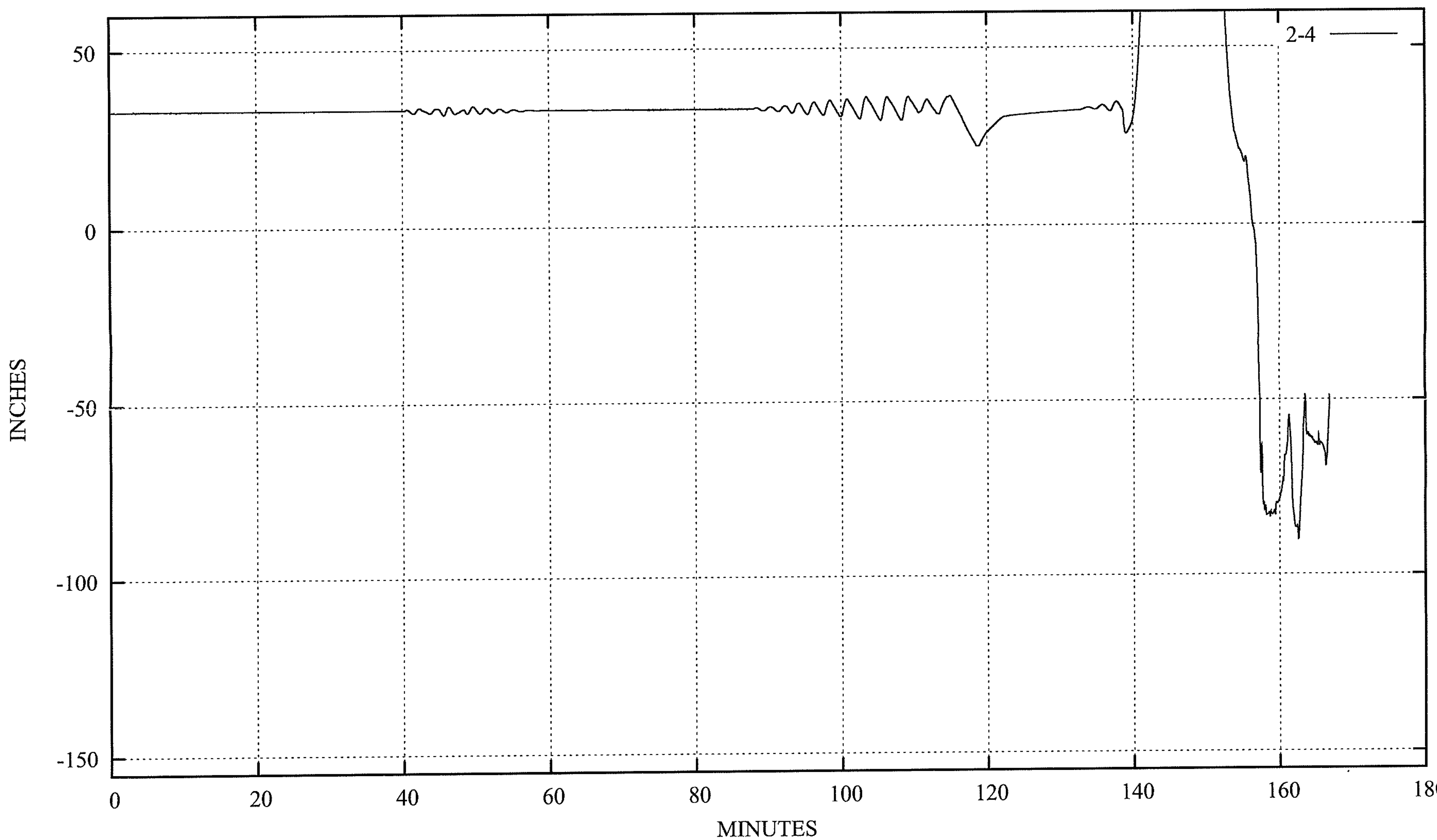
PLOT-23

Tue Jan 20 15:27:25 2015

Scenario 3 Crew B

1501 NRC Exam - Unit 2 Simulator

X-4 - ZAOLI0358A INCHES REACTOR LEVEL EMERG SYS RANGE [32.9539 : -90.2832 : 88.2989 : -48.8395]



1-X - /usr/tmp/plout.22458 -
2-X - NRC-3B.d - Tue Jan 20 13:48:09 2015

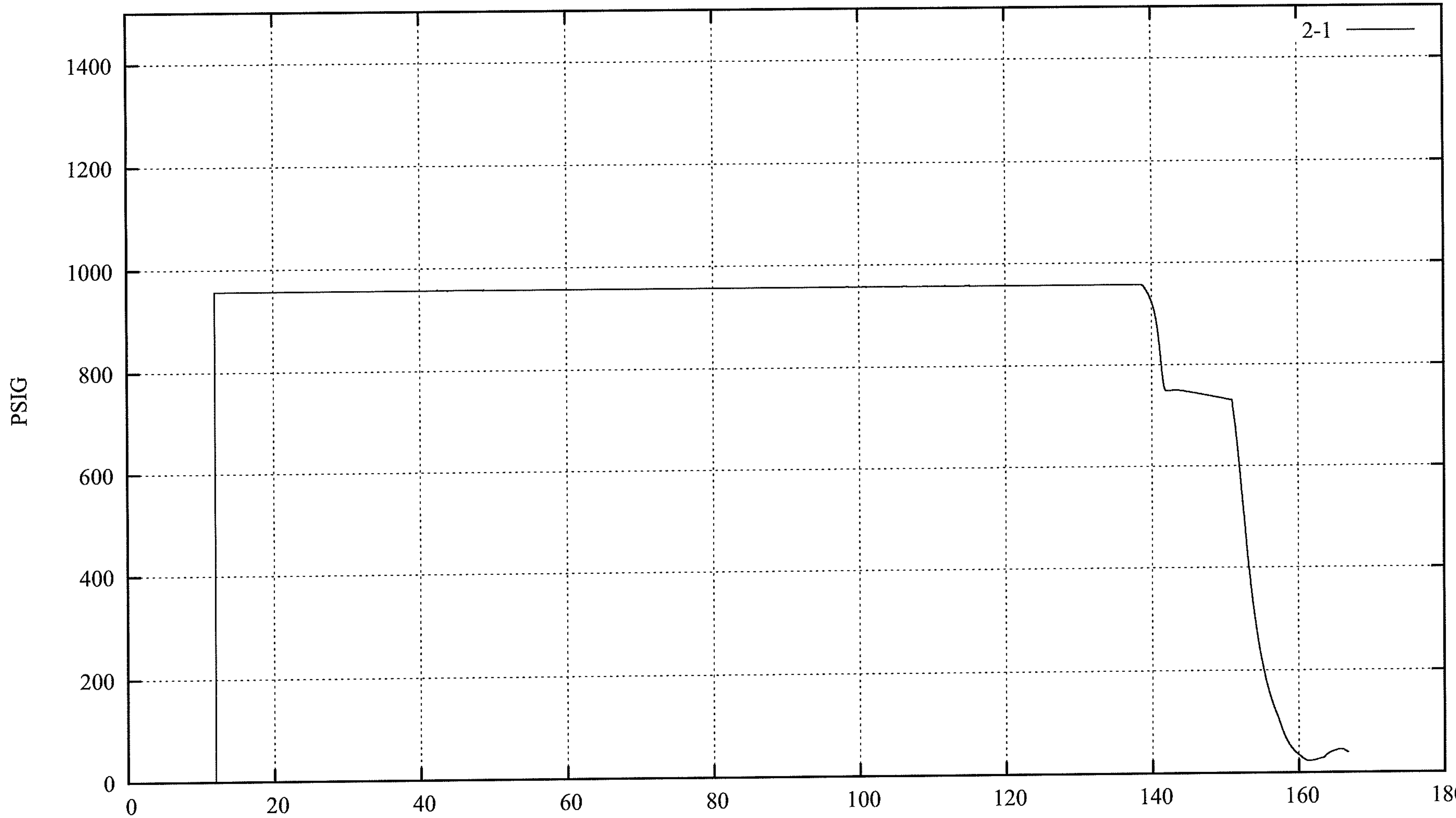
PLOT-4

Tue Jan 20 15:24:26 2015

Scenario 3 Crew B

1501 NRC Exam - Unit 2 Simulator

X-1 - ZAOPR0353 PSIG REACTOR PRESSURE [0.012213 : 0.012213 : 958.035 : 38.1275]



1-X - /usr/tmp/plout.21987 -
2-X - NRC-3B.d - Tue Jan 20 13:48:09 2015

PLOT-1

Tue Jan 20 15:23:58 2015

Post Operating Exam Comment #3

JPM Number 631 Restore Offsite Power to 4KV shutdown board at PNL 9-23 U-2

Step 17.1 as currently written is a Critical Step and states:
USE the associated Diesel Generator's governor control switch and voltage regulator control switch to reduce generator load to approximately 300 kW and 250 kVAR:

Applicant Performance:

At least one Applicant did not lower the Diesel Generator to 250 kVAR prior to performing Step 17.2 **PLACE** the associated Diesel Generator breaker control switch in TRIP.

Bases for Post Exam Comment:

There is a caution at 0-OI-82 step 8.3[17] that states:
When unloading the Diesel Generator, failure to slowly approach the 300 kW/250 kVAR limit may result in a reverse power trip of the Diesel Generator output breaker.

This caution is the bases for the lower limit while unloading the Diesel Generator. According to the Siemens 5KV breaker vendor manual (BFN VTD-S106-0040) the Diesel Generator breaker has a normal interrupting capability of 10,000 amps and a short circuit interrupting capability of 29,000 amps.
While Unloading the Diesel Generator to approximately 300KW and 250 kVAR limits the electrical arch produced when the Diesel Generator breaker is opened, the breaker is designed to open and extinguish the electrical arch under more than rated load conditions. No bases was found for an upper limit on kW or kVAR prior to opening the Diesel Generator breaker.

See the attached E-mail from Ron Stowe Mgr, Engineering Operations Support.

Based on a review of the Facility procedures and the vendor manual for the Diesel Generator breaker, the facility recommends that Step 17.1 of the JPM Not be considered a Critical step.

Nichols, Keith A

From: Nichols, Keith A
Sent: Friday, January 30, 2015 12:51 PM
To: Barton, Michael Alan
Subject: FW: D/G breaker

From: Stowe, Ronald H
Sent: Friday, January 30, 2015 10:23 AM
To: Nichols, Keith A
Subject: RE: D/G breaker

The Diesel Generator Output Breaker is a Siemens 5KV Horizontal Vacuum Circuit Breaker. Type 5-3AF-GEH-250-1200-58 and Type 5-3AF-GEH-250-2000-58 (of which the UNID of the Diesel Generator Output Breaker references) are discussed in Vendor Manual BFN-VTD-S106-0040 . The vendor manual discusses 2 parameters that are important concerning the breaker. The first is that the breaker has a normal interrupting capability of 10,000 amps. It also has a Short Circuit interrupting capability of 29,000 amps. Both of these limits are far above the full load amps going thru the circuit breaker. In other words the breaker is well capable of being opened at full load at any time.
Any limit to when the breaker should be opened (separating from the grid) would be just to minimize system perturbations. There is no other limits or restrictions that we could find on this subject.

Post Operating Exam Comment #4

JPM Number 631 Restore Offsite Power to 4KV shutdown board at PNL 9-23 U-2

Step 2 states: **VERIFY** the associated 4kV shutdown board auto transfer lockout relay is tripped to MANUAL.

Applicant Performance:

At least one Applicant placed the 4KV shutdown bus 1 auto transfer lockout relay in manual.

Bases for Post Exam Comment:

Placing 4KV shutdown bus 1 auto transfer lockout relay in manual was not in accordance with the procedure in use.
There was no immediate adverse consequence to this action however, if the normal power supply to the 4KV shutdown bus was lost in this condition the shutdown bus would be de-energized and the A and B Diesel Generators would receive an auto start and would supply the A and B 4KV shutdown boards.

0-OI-57A and 1-45E721 addresses the 4KV shutdown bus 1 auto transfer logic being inoperable. The only restriction in this condition is to block auto transfer of 4KV unit board 1A (see attached).

An EOOS (risk analysis) what if case has been performed for the condition in which the 4KV shutdown bus 1 is de-energized since this is the worst case without assuming additional failures. The analysis showed that both core damage frequency (CDF) and large early release fraction (LERF) remain Green (acceptable).
The CDF changed from 3.40E-6 to 1.32E-5.
The LERF changed from 6.27E-7 to 1.64E-6.

Based on this information the Facility recommends that no new critical task was created by the incorrect action.

Illustration 6
(Page 5 of 6)
Limiting Conditions

LIMITING CONDITIONS FOR TRANSFER OF 4kV START BUS TO THE SAME CSST

Limiting Condition	AFFECTED BOARD OR BUSS									
	UB 1C	UB 2C	UB 3A	Unit 1 4kV Aux Power Sys	Unit 2 4kV Aux Power Sys	Unit 3 4kV Aux Power Sys	4kV Common Bds A & B	Start Bus 1A Start Bus 2A	Start Bus 1B Start Bus 2B	Shutdown Bds
Start Buses 1A & 1B 2A & 2B fed from A CSST	BK Auto Xfer Must be fed from USST (1)	BK Auto Xfer Must be fed from USST (1)	BK Auto Xfer Must be fed from USST (1)	All 4kV Boards Normal feed from USST (1)	All 4kV Boards Normal feed from USST (1)	All 4kV Boards Normal feed from USST (1)	Normal feed from USST (1)	No pre-load on Start Bus 2A (3) (4)	No pre-load on Start Bus 2A (3) (4)	All SD Bds Aligned Normal (1)
Start Buses 1A & 1B 2A & 2B fed from B CSST	BK Auto Xfer Must be fed from USST (2)	BK Auto Xfer Must be fed from USST (2)	BK Auto Xfer Must be fed from USST (2)	All 4kV Boards Normal feed from USST (2)	All 4kV Boards Normal feed from USST (2)	All 4kV Boards Normal feed from USST (2)	Normal feed from USST (2)	No pre-load on Start Bus 2A (5) (6)	No pre-load on Start Bus 2A (5) (6)	All SD Bds Aligned Normal (1)

LIMITING CONDITIONS ASSOCIATED WITH 4kV SHUTDOWN BOARDS AND BUSSES

Limiting Condition	AFFECTED BOARD OR BUSS				
	UB 1A	UB 1B	UB 2A	UB 2B	Shutdown Bd C
Shutdown Bd C on Alt feed (SD Bus 1)					Limit load to 340 amps May exceed 340 amps one time for max 100 hrs. (11)
SD Bus 1 on Alt feed				BK Auto Xfer to Start Bus (9)	
SD Bus 1 Auto Xfer Inop	BK Auto Xfer to Start Bus (8)				
SD Bus 2 on Alt feed		BK Auto Xfer to Start Bus (7)			
SD Bus 2 Auto Xfer Inop			BK Auto Xfer to Start Bus (10)		

Print Reference Notes

(1) 0-45E715 OPL 2	(3) 1-45E718 OPL3	(5) 1-45E718 OPL4	(7) 1-45E721 OPL5	(9) 2-45E721 OPL4	(11) 0-45E724-3 OPL
(2) 0-45E715 OPL 3	(4) 2-45E718 OPL3	(6) 2-45E718 OPL4	(8) 1-45E721 OPL6	(10) 2-45E721 OPL5	

033	TACF 1-11-008-027 R1	BKR	B Campbell	DP Walker	12-12-11
REVISED PER TACF 1-11-008-027 R1 (RETURN TO NORMAL)					
REV	CHANGE REF	PREPARER	CHECKER	APPROVED	DATE

B

SCALE: NONE EXCEPT AS NOTED

POWERHOUSE
UNIT 1

SYSTEM NO.
57-5 (202),24

WIRING DIAGRAM
4160V UNIT BDS 1A, 1B, 1C
SINGLE LINE

BROWNS FERRY NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY

DESIGN		DISCIPLINE INTERFACE		ENGINEERING APPROVAL
DRAWN TOG	CHECKED ERS/GWN	1 N/A	2 N/A	C. McCORD
DESIGNED DWA	REVIEWED J. G. SAVERY	3 N/A	4 N/A	

A

KNOXVILLE	DATE 1-16-68	67	E	1-45E721	R033

CAD MAINTAINED DRAWING

CCD

OPL6 - WHEN 4KV UNIT BOARD 2B IS NOT AVAILABLE AS PART OF THE 500KV OFFSITE CIRCUIT TO 4KV SHUTDOWN BUS 1, OR 4KV SHUTDOWN BUS 1 AUTOMATIC TRANSFER LOGIC IS INOPERABLE, BLOCK AUTO TRANSFER OF 4KV UNIT BOARD 1A BY PLACING ITS 43 SWITCH IN MANUAL.