Human Factors Verification and Validation Scenarios

Technical Report

Non-Proprietary

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Revision History

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ABSTRACT

The purpose of Human Factors Verification and Validation (HF V&V) Scenarios is to identify operational conditions and scenarios to be used for HSI task support verification, design verification and integrated system validation. HF V&V Scenarios provide detailed scenarios suitable for use on a full-scope simulator

HF V&V Scenarios in this Technical Report contain sampling of operational conditions, summary of APR1400 probabilistic safety assessment, and HF V&V scenarios.

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List of Acronyms

AAC	alternate alternating current
AFWP	auxiliary feedwater pump
AOP	abnormal operating procedure
ATWT	anticipated transient without trip
CBP	computer-based procedure
CCW	component cooling water
CCWP	component cooling water pump
CSF	critical safety function
CVCS	chemical and volume control system
DG	diesel generator
EDG	emergency diesel generator
EO	electrical operator
EOF	emergency operating facility
EOP	emergency operating procedure
ESDE	excessive steam demand event
ESWP	essential service water pump
HA	human action
HSI	human system interface
ISV	integrated system validation
LCO	limiting conditions of operation
LOAF	loss of all feedwater
LOCA	loss of coolant accident
LDP	large display panel
LOOP	loss of offsite power
LPMS	loose part monitoring system
MCR	main control room
MFWP	main feedwater pump
NRC	U.S. Nuclear Regulatory Commission
OER	operating experience review
RCP	reactor coolant pump
RCS	reactor coolant system
RO	reactor operator
RSR	remote shutdown room
SBO	station black out
SBLOCA	small break loss of coolant accident
SCS	shutdown cooling system

SG	steam generator
SGTR	steam generator tube rupture
SIAS	safety injection actuation signal
SS	shift supervisor
STA	shift technical advisor
TO	turbine operator
TSC	technical support center
VCT	volume control tank
V&V	verification and validation

1.0 OVERVIEW

1.1 Purpose

The purpose of Human Factors Verification and Validation (HF V&V) Scenarios is to identify operational conditions and scenarios to be used for HSI Task Support Verification, Design Verification and Integrated System Validation (ISV). V&V Scenarios provide detailed scenarios suitable for use on a full-scope simulator.

1.2 Scope

The following information is defined to reasonably assure that important dimensions of performance are addressed, and to allow the scenarios to be accurately and consistently presented for repeated trials:

- a description of the scenario and any pertinent prior history necessary for personnel to understand the state of the plant at the start-up of the scenario
- specific initial conditions (a precise definition of the plant's functions, processes, systems, component conditions, and performance parameters, e.g., similar to that at shift turnover)
- events (e.g., failures) that will occur during the scenario and their initiating conditions, e.g., based on time, or a value of a specific parameter
- precise definition of workplace factors, (e.g., environmental conditions, such as low levels of illumination)
- needs for task support (e.g., procedures and technical specifications)
- staffing level
- details of communication content between control room personnel and remote personnel (e.g., load dispatcher via telephone)
- scripted responses for test personnel who will act as plant personnel in the test scenarios

2.0 APPLICABLE DOCUMENTS

1. U.S. NRC, “Human Factors Engineering Program Review Model," NUREG-0711, Rev. 3, 2012.
2. U.S. NRC, "Standard Review Plan," NUREG-0800, Rev. 2, 2007.
3. U.S NRC, “Human-System Interface Design Review Guidelines,” NUREG-0700, Rev.2. 2002.
4. U.S. NRC, “Integrated System Validation: Methodology and Review Criteria,” NUREG/CR-6393, 1997.
5. KHNP, APR1400-E-J-NR-12010-P, “ HF V&V Implementation Plan,” September 2013.

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APPENDIX 1

Small Break Loss of Coolant Accident (SBLOCA) with Computer Based Procedure (CBP)/Displays Failures

ISV-1

CONTENTS

1. No/TITLE: ISV-1, Small Break Loss of Coolant Accident (SBLOCA) and CBP/Display Failure

2. OBJECTIVES:

Validate that the integrated system adequately supports plant personnel in safely operating the plant during various equipment malfunctions including a SBLOCA, as follows:

a. Validate the shift staffing level is adequate to support performance of crewmember tasks and allow for adequate crew interaction.
b. Validate that the design has adequate capability for alerting, informing, controlling, and feedback such that personnel tasks are successfully completed during the accident response.
c. Validate specific personnel tasks can be accomplished within specific time and performance criteria.
d. Validate that the HSIs minimize personnel error and assure error detection and recovery capability when errors occur.
e. Validate that the personnel can effectively transition between the HSIs and procedures in accomplishing their tasks.

3. OVERVIEW of SCENARIO

During steady state full power operation a SG 1 Downcomer High Radiation monitor alarm is received. The crew responds and determines the alarm is due to a failed instrument. Subsequently a SBLOCA occurs; the reactor automatically trips, and the safety injection setpoint is exceeded but the SI does not automatically initiate. The crew manually initiates SI in response. Operators start emergency operation by entering EOP-1001 “Standard Post Trip Action”. After taking the post trip actions, operators diagnose the LOCA following entry into EOP-1002 “Diagnostic Action”. According to the results of accident diagnosis, operators enter and

perform the steps of EOP-2002 ”Loss of Coolant Accident”. The Computer Based Procedure System (CBP) fails during the performance of EOP-2002. Operators transition to the hard copy of EOP-2002 and continue the emergency operation. All HSI displays, including the operator console displays and LDP, fail, forcing the operator to the safety console. The scenario concludes when the RCS is cooled and depressurized to the point that the Shutdown Cooling System (SCS) can be placed in serviced.

4. ANTICIPATED PROCEDURE FLOWPATH

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5. PREPARATION of EVALUATION

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6. MAJOR STEPS of SCENARIO

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9.3 EVENT-2 SG1 DOWNCOMER RADIATION FAIL HI

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[POP-01: Standard Post Trip Actions]

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[POP-02: Diagnostic Actions]

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[EOP-02: Loss of Coolant Accident]

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9.5 EVENT-4 Computer Based Procedure System (CBP) Fail

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9.6 EVENT-5 All Display of Operator Consoles and LDP Fail

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9.7 EVENT-6 RCS Cooldown at Safety Console

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9.8 POST EXERCISE EVALUATION

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9.9 DATA ACQUISITION

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10. INSTRUCTOR AIDs

a. TRENDING PARAMETERs for SBLOCA (Trend file: mf_ISV-1)

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b. Malfunctions/Remote/Override List

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c. ANTICIPATED DIALOG SCRIPTs

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d. SHIFT TURNOVER SHEET

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APPENDIX 2

Anticipated Transient Without Trip (ATWT) with Ovation Distributed Control System (DCS) Failures

ISV-2

CONTENTS

1. No/TITLE: ISV-2, Anticipated Transient Without Trip (ATWT) with Ovation Distributed Control System (DCS) Failures

2. OBJECTIVES:

Validate that the integrated system adequately supports plant personnel in safely operating the plant during various equipment malfunctions including an ATWT with Ovation DCS failures, as follows:

a. Validate the shift staffing level is adequate to support performance of crewmember tasks and allow for adequate crew interaction.
b. Validate that the design has adequate capability for alerting, informing, controlling, and feedback such that personnel tasks are successfully completed during the accident response.
c. Validate specific personnel tasks can be accomplished within specific time and performance criteria.
d. Validate that the HSIs minimize personnel error and assure error detection and recovery capability when errors occur.
e. Validate that the personnel can effectively transition between the HSIs and procedures in accomplishing their tasks.

3. OVERVIEW of SCENARIO

Unit is in Hot Standby (HSB) condition after the completion of core physics test. The crew attains core criticality by withdrawal of regulating group rods and increases power up to 2%. At 2% power, the crew rolls up a turbine driven Main Feedwater Pump (MFWP) and stop Start-up Feedwater Pump (SUFWP). During the power increase to 8% for turbine rolling, a charging control valve (CV-212P) fails closed. After recovery from the event PZR spray valve (RC-100E) fails open causing an uncontrolled RCS depressurization. The RO tries to close the isolation valve of the spray valve but it fails

due to sticking of the isolation valve. The SRO orders a reactor trip in response. The RO attempts to trip the reactor but it will not trip. After recognition of the ATWT condition the RO trips the reactor by interrupting the power to MG sets. Following the successful reactor trip the Ovation DCS fails. All HSI alarms, displays, controls, and CBPs on the LDP and Operator Consoles are failed off. The crew can no longer monitor nor control the plant from the Operator Console. The SRO orders the crew to transit to the Safety Console. At the Safety Console, the crew maintains core cooling with minimum inventory of HSI alarms, displays and controls. When the stabilized RCS cooldown rate is attained, the scenario will be closed out.

4. ANTICIPATED PROCEDURE FLOWPATH

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5. PREPARATION of EVALUATION

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6. MAJOR STEPS of SCENARIO

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7. PRIMARY TASK PERFORMANCE MEASURES

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8. OTHER PERFORMANCE MEASURES APPLICABLE THROUGHOUT SCENARIO

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9. SIMULATOR EXERCISE EVALUATION PLAN

9.1 INITIAL CONDITIONS/SIMULATOR SETUP

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9.2 EVENT-1 HSB to 25% POWER OPERATION

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9.3 EVENT-2 CHARGING CONTROL VALVE (CV-212P) FAIL CLOSE

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9.4 EVENT-3 PZR SPRAY VALVE FAILS OPEN with ANTICIPATED TRANSIENT WITHOUT TRIP (ATWT)

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[POP-01: Standard Post Trip Actions]

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[POP-02: Diagnostic Actions]

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[EOP-01: Reactor Trip Recovery]

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9.5 EVENT-4 OVATION DCS FAILURES (Common Mode Failures)

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9.6 EVENT-4 COOLDOWN RCS at SAFETY CONSOLE with Ovation DCS Failures

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9.7 POST EXERCISE EVALUATION

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9.8 DATA ACQUISITION

10. INSTRUCTOR AIDs

a. TRENDING PARAMETERs for ATWT with Ovation DCS Failures (Trend file: mf_ISV-2)

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b. Malfunctions/Remote Functions/Override List

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c. ANTICIPATED DIALOG SCRIPTs

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d. SHIFT TURNOVER SHEET

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APPENDIX 3

Excessive Steam Demand Event (ESDE) with Alarm Server Failures

ISV-3

CONTENTS

1. No/TITLE: ISV-3, Excessive Steam Demand Event (ESDE) with Alarm Server Failures

2. OBJECTIVES:

Validate that the integrated system adequately supports plant personnel in safely operating the plant during various equipment malfunctions including an Excessive Steam Demand Event with Alarm Server failures, as follows:

a. Validate the shift staffing level is adequate to support performance of crewmember tasks and allow for adequate crew interaction.
b. Validate that the design has adequate capability for alerting, informing, controlling, and feedback such that personnel tasks are successfully completed during the accident response.
c. Validate specific personnel tasks can be accomplished within specific time and performance criteria.
d. Validate that the HSIs minimize personnel error and assure error detection and recovery capability when errors occur.
e. Validate that the personnel can effectively transition between the HSIs and procedures in accomplishing their tasks.

3. OVERVIEW of SCENARIO

During steady state full power operation the operators are scheduled to perform a monthly control rod partial movement monthly surveillance test. During the test, the Loose Part Monitoring System (LPMS) detects an abnormal signal and the operators initiate an analysis as directed by procedure. Subsequently, a L/D Hx tube leak occurs as indicated by CCW hi radiation alarms and a CCST hi level alarm. The crew diagnoses the event and isolates CVCS charging and letdown to repair the failed tube. The LPMS analysis indicates there is likely debris in the reactor core. The Site Manger directs the operating crew to commence a plant shutdown to Mode 4 in preparation for a maintenance outage to inspect the core. He requests the crew be in mode 3 within two hours. The crew briefs and begins a power decrease. During the power

decrease, two MFWPs trip, but the RPCS does not function automatically as expected. The RO drops a selected control rod and unloads the turbine rapidly in order to stabilize the plant. At 25% power alarm server A and B fails. The SRO declares a site emergency per the emergency plan. The crew continues the power decrease to 50MWs and trips the turbine. Following the reactor shutdown, a steam line break inside CNMT occurs. The crew starts emergency operation by entering POP-01 “Standard Post Trip Action”. After taking the post trip actions, the crew performs POP-02 “Diagnostic Action”. According to the results of accident diagnosis, the crew enters and performs the steps of EOP-04 ”Excessive Steam Demand Event” without alarms. When the RCS is cooldown below 230℃, the scenario will be closed out.

4. ANTICIPATED PROCEDURE FLOWPATH

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5. PREPARATION of EVALUATION

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6. MAJOR STEPS of SCENARIO

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7. PRIMARY TASK PERFORMANCE MEASURES

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8. OTHER PERFORMANCE MEASURES APPLICABLE THROUGHOUT SCENARIO

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9. SIMULATOR EXERCISE EVALUATION PLAN

9.1 INITIAL CONDITIONS/SIMULATOR SETUP

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9.2 EVENT-1 CONTROL ROD PARTIAL MOVEMENT SURVEILLANCE TEST

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9.3 EVENT-2 CVCS LETDOWN Hx TUBE LEAK

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9.4 EVENT-3 100% to HOTSTANDBY SHUTDOWN OPERATION

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9.5 EVENT-4 TWO MFWPs TRIP with AUTOMATIC INITIATION FAILURE of RPCS

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9.6 EVENT-5 ALRAM SERVER A and B FAILURES

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9.7 EVENT-6 MAIN STEAM LINE 2B BREAK inside CONTAINMENT

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[POP-02 : Diagnostic Actions]

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[EOP-04 : Excessive Steam Demand Event]

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9.8 POST EXERCISE EVALUATION

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9.9 DATA ACQUISITION

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10. INSTRUCTOR AIDs

a. TRENDING PARAMETERs for ESDE (Trend parameters file: mf_ISV-3)

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b. Malfunctions/Remote/Override List

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c. ANTICIPATED DIALOG SCRIPTs

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d. SHIFT TURNOVER SHEET

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APPENDIX 4

Loss of All Feedwater (LOAF)

ISV-4

CONTENTS

1. No/TITLE: ISV-4, Loss of All Feedwater (LOAF)

2. OBJECTIVES:

Validate that the integrated system adequately supports plant personnel in safely operating the plant during various equipment malfunctions including an Loss of All Feedwater, as follows:

a. Validate the shift staffing level is adequate to support performance of crewmember tasks and allow for adequate crew interaction.

b. Validate that the design has adequate capability for alerting, informing, controlling, and feedback such that personnel tasks are successfully completed during the accident response.

c. Validate specific personnel tasks can be accomplished within specific time and performance criteria.

d. Validate that the HSIs minimize personnel error and assure error detection and recovery capability when errors occur.

e. Validate that the personnel can effectively transition between the HSIs and procedures in accomplishing their tasks.

3. OVERVIEW of SCENARIO

Following shift turnover, the TO starts the TD AFWP 1B monthly surveillance test per the schedule. After reaching rated speed, the turbine trips due to failure of the overspeed trip mechanism. The 1B TDAFWP Limiting Conditions of Operation (LCO) is applied per technical specifications. Subsequently a CVCS letdown line leak forms upstream of letdown control valve CV-201P/Q but malfunctioning local radiation monitors do not alarm. The RO locates the leak using multiple control room indications along with a field inspection by the local operator. The crew stops the leak by isolating the CVCS letdown line. Soon afterward, a bus fault occurs at the two 13.8kV Non-1E buses causing all 13.8kV motors to stop, including: MFWP booster pumps, SUFWP, COPs, and CWPs. The unit trips due to the loss of

condenser vacuum and loss of SG feedwater. MD AFWPs are started by the Auxiliary Feedwater Actuation Signal (AFAS) but the TD AFWP 1A fails to start because the steam supply valve to the turbine is stuck closed. The crew enters POP-01 “Standard Post Trip Action” and POP-02 ”Diagnostic Actions”. During diagnostics, two MD AFWPs are tripped in sequence by overload resulting in a loss of all SG feedwater. The crew re-diagnoses the event per POP-02 “Diagnostic Actions” and enters to EOP-05, “Loss of All Feedwater”. The scenario will be closed out when stable RCS cooling conditions are established using FRG-06 “Core and RCS heat removal”.

4. ANTICIPATED PROCEDURE FLOWPATH

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5. PREPARATION of EVALUATION

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6. MAJOR STEPS of SCENARIO

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7. PRIMARY TASK PERFORMANCE MEASURES

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8. OTHER PERFORMANCE MEASURES APPLICABLE THROUGHOUT SCENARIO

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9. SIMULATOR EXERCISE EVALUATION PLAN

9.1 INITIAL CONDITIONS/SIMULATOR SETUP

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9.2 EVENT-1 TD AFWP 1B SUVEILLANCE TEST

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9.3 EVENT-2 CVCS LETDOWN LINE LEAK upstream CONTROL VALVE CV-201P/Q

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9.4 EVENT-3 13.8kV SW-02M, SW-02N BUS FAULT

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[POP-01: Standard Post Trip Actions]

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[POP-02: Diagnostic Actions]

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9.5 EVENT-4: LOSS of ALL FEEDWATER (LOAF)

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[EOP-01: Reactor Trip Recovery]

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[POP-02: Diagnostic Actions]

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[EOP-05: Loss of All Feedwater]

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[FRP-06: Core and RCS Heat removal, Success Path HR-3 once through cooling]

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9.6 POST EXERCISE EVALUATION

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9.7 DATA ACQUISITION

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10. INSTRUCTOR AIDs

a. TRENDING PARAMETERs for LOAF (Trend file: mf_ISV-4)

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b. Malfunctions/Remote/Override List

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c. ANTICIPATED DIALOG SCRIPTs

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d. SHIFT TURNOVER SHEET

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APPENDIX 5

Station Black Out (SBO)

ISV-5

CONTENTS

1. No/TITLE: ISV-5, Station Black Out (SBO)

2. OBJECTIVESs:

Validate that the integrated system adequately supports plant personnel in safely operating the plant during various equipment malfunctions including a Station Black Out, as follows:

a. Validate the shift staffing level is adequate to support performance of crewmember tasks and allow for adequate crew interaction.
b. Validate that the design has adequate capability for alerting, informing, controlling, and feedback such that personnel tasks are successfully completed during the accident response.
c. Validate specific personnel tasks can be accomplished within specific time and performance criteria.
d. Validate that the HSIs minimize personnel error and assure error detection and recovery capability when errors occur.
e. Validate that the personnel can effectively transition between the HSIs and procedures in accomplishing their tasks.

3. OVERVIEW of SCENARIO

During steady state full power operation and as discussed at turnover, the Reactor Operator swaps the charging pumps per the monthly equipment rotation schedule. As soon as CHG Pump 01A is shutdown, VCT level transmitter LT-227 fails to low. Charging pump suction valve is transferred to the BAST and begins injection of high borated water to RCS. Reactor Operator minimizes charging flow and makes a request to the I&C team to inspect the transmitter. The crew stabilizes the plant following the unplanned boration. Upon restoring the charging pump suction to the VCT, the deaerator level controller LIK-318NO1 fails low and the valve to the deaerator closes. The Turbine Operator swaps to the standby channel and restores the valve to the open position. The Load Dispatch Center calls with a report that a tornado is approaching the site

and orders the SRO to decrease unit power to 75% due to associated transmission line load and grid instability. During the power decrease, offsite power is lost and the unit trips. EDG B starts automatically but EDG A fails to start for unknown reasons. The crew enters POP-01 “Standard Post Trip Actions”, POP-02 “Diagnostic Actions”, and then transitions to EOP-06 “Loss of Offsite Power/Loss of Forced Circulation”. EDG B trips during EOP-06 execution. Because the AAC DG is Out of Service (OOS) for maintenance, the crew enters EOP-07 “Station Black Out” using re-diagnosis of the event per POP-02 “Diagnostic Actions”. The crew maintains RCS cooling using the SGs, which are being fed by the TD AFWPs per EOP-07. When one 4.16kV class-1E bus is reenergized by EDG A, and the minimum required vital equipment is restored, the scenario will be closed out.

4. ANTICIPATED PROCEDURE FLOWPATH

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5. PREPARATION of EVALUATION

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6. MAJOR STEPS of SCENARIO

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7. PRIMARY TASK PERFORMANCE MEASURES

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8. OTHER PERFORMANCE MEASURES APPLICABLE THROUGHOUT SCENARIO

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9. SIMULATOR EXERCISE EVALUATION PLAN

9.1 INITIAL CONDITIONS/SIMULATOR SETUP

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9.2 EVENT-1 ROTATE CHARGING PUMP from 1A to 1B

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9.3 EVENT-2 CVCS VCT LT-227 FAIL LOW

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9.4 EVENT-3 DEAERATOR LEVEL CONTROLLER LIK-0318NO1 FAIL LOW

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9.5 EVENT-4 100% to 75% POWER OPERAITON

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9.6 EVENT-5 LOSS of OFFSITE POWER

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[POP-01: Standard Post Trip Actions]

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[POP-02: Diagnostic Actions]

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[EOP-06: Loss of Offsite Power/Loss of Forced Circulation]

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9.7 EVENT-6 STATION BLACK OUT

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[POP-02: Diagnostic Actions]

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[EOP-07: Station Black Out]

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9.8 POST EXERCISE EVALUATION

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9.9 DATA ACQUISITION

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10. INSTRUCTOR AIDs

a. TRENDING PARAMETERs for SBO (Trend file: mf_ISV-5)

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b. Malfunctions/Remote/Override List

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c. ANTICIPATED DIALOG SCRIPTs

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d. SHIFT TURNOVER SHEET

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APPENDIX 6

Steam Generator Tube Rupture (SGTR)

ISV-6

CONTENTS

1. No/TITLE: ISV-6, Steam Generator Tube Rupture(SGTR)

2. OBJECTIVES:

Validate that the integrated system adequately supports plant personnel in safely operating the plant during various equipment malfunctions including a Steam Generator Tube Rupture, as follows:

a. Validate the shift staffing level is adequate to support performance of crewmember tasks and allow for adequate crew interaction.
b. Validate that the design has adequate capability for alerting, informing, controlling, and feedback such that personnel tasks are successfully completed during the accident response.
c. Validate specific personnel tasks can be accomplished within specific time and performance criteria.
d. Validate that the HSIs minimize personnel error and assure error detection and recovery capability when errors occur.
e. Validate that the personnel can effectively transition between the HSIs and procedures in accomplishing their tasks.

3. OVERVIEW of SCENARIO

During steady state full power operation, the Reactor Operator starts the CCW pump rotate operation per monthly schedule. During the B train rotate operation, the Reactor Operator finds no indication of discharge flow for 2B pump started. Inspection reveals the root valves closed. Subsequently, condenser hotwell sodium high alarm initiated. As the alarm is identified as true, The Turbine Operator starts isolation of suspected condenser per AOP-3530. After isolating the condenser, the crew starts decreasing power to 75% by request of Load Dispatch Center. After a while, the Reactor Operator finds control rods fully withdrawn and Tavg channel failed to low. After clear them, the Reactor Operator recognizes the VCT level decreased slightly and tries to find the cause with failed secondary side radiation monitoring.

After all, the crew concludes that a SG 1 tube leak has occurred and the radioactivity exceeded operating limit by sampling the blowdown. During the rapid power decrease, SGTR occurs and the reactor trips. The crew starts emergency operation per POP-01 “Standard Post Trip Actions” and POP-02 “Diagnostic Actions”. According to the results of accident diagnosis, the crew performs the steps of EOP-03, ”SGTR”. When the SDC entry conditions are established, the scenario will be closed out.

4. ANTICIPATED PROCEDURE FLOWPATH

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5. PREPARATION of EVALUATION

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6. MAJOR STEPS of SCENARIO

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7. PRIMARY TASK PERFORMANCE MEASURES

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8. OTHER PERFORMANCE MEASURES APPLICABLE THROUGHOUT SCENARIO

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9. SIMULATOR EXERCISE EVALUATION PLAN

9.1 INITIAL CONDITIONS/SIMULATOR SETUP

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9.2 EVENT-1 ROTATE of CHARGING PUMP from 1A, 1B to 2A,2B

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9.3 EVENT-2 CONDENSER A TUBE LEAK(Hotwell Left)

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9.4 EVENT-3 100% to 75% POWER OPERATION

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9.5 EVENT-4 RRS Tavg FAIL LOW

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9.6 EVENT-5 STEAM GENERATOR TUBE LEAK with 2ry RADIATION MONITORING FAILURES

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9.7 EVENT-6 STEAM GENERATOR TUBE RUPTURE(SGTR)

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[POP-01: Standard Post Trip Actions]

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[POP-02: Diagnostic Actions]

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[EOP-03: Steam Generator Tube Rupture]

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9.8 POST EXERCISE EVALUATION

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9.9 DATA ACQUISITION

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10. INSTRUCTOR AIDs

a. TRENDING PARAMETERs for SGTR (Trend file: mf_ISV-6)

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b. Malfunctions/Remote/Override List

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c. ANTICIPATED DIALOG SCRIPTs

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d. SHIFT TURNOVER SHEET

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APPENDIX 7

Main Control Room Fire

ISV-7

CONTENTS

1. No/TITLE: ISV-7, Main Control Room Fire

2. OBJECTIVESs:

Validate that the integrated system adequately supports plant personnel in safely operating the plant during various equipment malfunctions including a Main Control Room Fire, as follows:

a. Validate the shift staffing level is adequate to support performance of crewmember tasks and allow for adequate crew interaction.
b. Validate that the design has adequate capability for alerting, informing, controlling, and feedback such that personnel tasks are successfully completed during the accident response.
c. Validate specific personnel tasks can be accomplished within specific time and performance criteria.
d. Validate that the HSIs minimize personnel error and assure error detection and recovery capability when errors occur.
e. Validate that the personnel can effectively transition between the HSIs and procedures in accomplishing their tasks.

3. OVERVIEW of SCENARIO

During steady state full power operation, MFWP B vibration high alarm is received. TO requests Preventive Maintenance(PM) team to diagnose the vibration of MFWP B. PM reports that the vibration graph indicates a damage of the pump bearings. Site manager decides to disassemble the bearing. The crew decreases the reactor power to 75% and shutdown MFWP B per SOP-3541-01. Subsequently, a leak in the CVCS charging line occurs, but no radiation alarm initiated. RO diagnoses the event and concludes that the leak occurs inside containment charging lines. After isolation of CHG/LD lines, the crew starts power decrease by maximum rate to 50MW and stops turbine/reactor manually per GOP-3004. During power decrease SG 2 FW master controller fails to low and recovered by the operator actions. As soon as RCS reached HSB condition, a MCR fire alarm is initiated and a smoke is out from the cable area of the MCR roof. The crew tries to suppress the fire by fire extinguishers, but fails. SRO decides to evacuate MCR and move to Remote Shutdown Room (RSR). At the RSR, the crew starts the RCS cooldown to CSD conditions per AOP-3754-01. When the RCS temperature is reached below 250℃, the scenario will be closed out.

4. ANTICIPATED PROCEDURE FLOWPATH

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5. PREPARATION of EVALUATION

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6. MAJOR STEPS of SCENARIO

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7. PRIMARY TASK PERFORMANCE MEASURES

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8. OTHER PERFORMANCE MEASURES APPLICABLE THROUGHOUT SCENARIO

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9. SIMULATOR EXERCISE EVALUATION PLAN

9.1 INITIAL CONDITIONS/SIMULATOR SETUP

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9.2 EVENT-1 MFWP B VIBRATION HIGH

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9.3 EVENT- 100% to 75% POWER OPERATION

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9.4 EVENT-3 CHARGING LINE LEAK inside CONTAINMENT with NO RADIATION ALARMS

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9.5 EVENT-4 75% to HSB POWER DECREASE at a MAXIMUM RATE

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9.6 EVENT-5 SG 2 FW MASTER CONTROLLER FAIL LOW

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9.7 EVENT-6 MAIN CONTRO ROOM FIRE

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9.8 EVENT-7 RCS COOLDOWN at REMOTE SHUTDOWN ROOM

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9.9 POST EXERCISE EVALUATION

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9.10 DATA ACQUISITION

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10. INSTRUCTOR AIDs

a. TRENDING PARAMETERs for MCR FIRE (Trend file: mf_ISV-7)

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b. Malfunctions/Remote/Override List

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c. ANTICIPATED DIALOG SCRIPTs

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d. SHIFT TURNOVER SHEET

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