Use of Computer-Based Procedures for the U.S. EPR

Desmond Raymond, Thad Wingo

AREVA NP Inc., Charlotte, NC

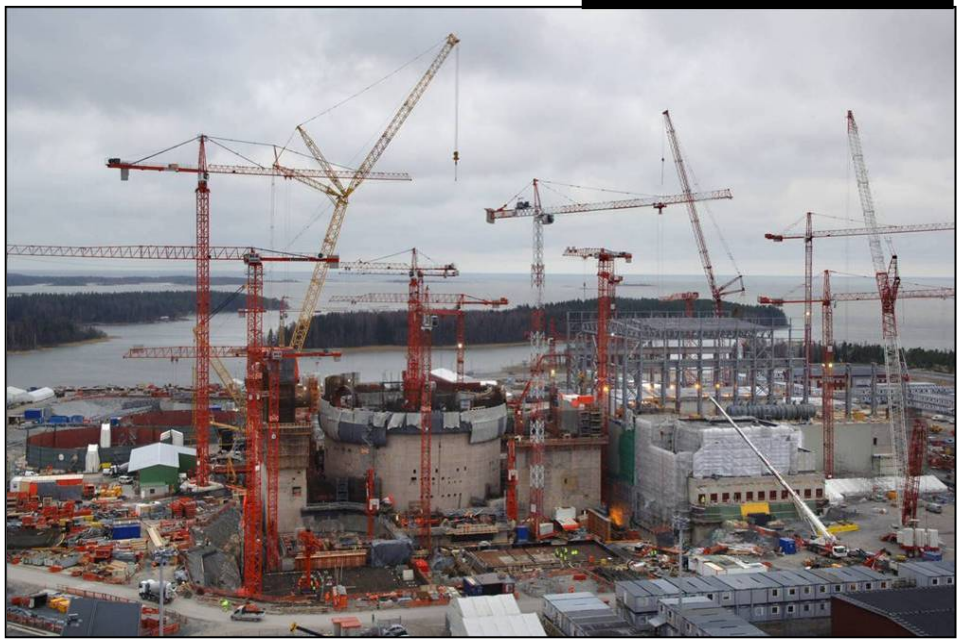
Introduction

- Computer Based Procedure (CBP) use at Olkiluoto 3 (OL3)
- Computer Based Procedure use at Flamanville 3 (FL3)
- Predecessor Plants' Related Operating Experience
- Computer Based Procedure Concept for the US EPR

OL3 use of Computer-Based Procedures

- OL3 is implementing CBPs on the Siemens OM690 HMI Platform
- OL3 is using CBPs for:
  1. Emergency Operating Procedures (EOPs)
  2. Normal Operating Procedures
  3. Alarm Reponses Procedures
- The CBPs are intelligent (i.e. real-time plant data is displayed and hyperlinks are provided to related control or procedure screens)
- No control capabilities are embedded in CBP

OL3 construction site



FA3 use of Computer-Based Procedures

- FA3 is implementing limited CBPs on the Siemens OM690 HMI Platform
- FA3 is not planning on computerizing EOPs or Normal Operating Procedures
- FA3 is planning on computerizing some equipment operational procedures and alarm response sheets

FA3 construction site

CBP Related Operation Experience

- In the 1990's, N4 plants implemented CBPs
- The lessons learned included:
  1. Problems with operator plant situational awareness
  2. Difficult transitions when using multiple procedures

N4 Control Room

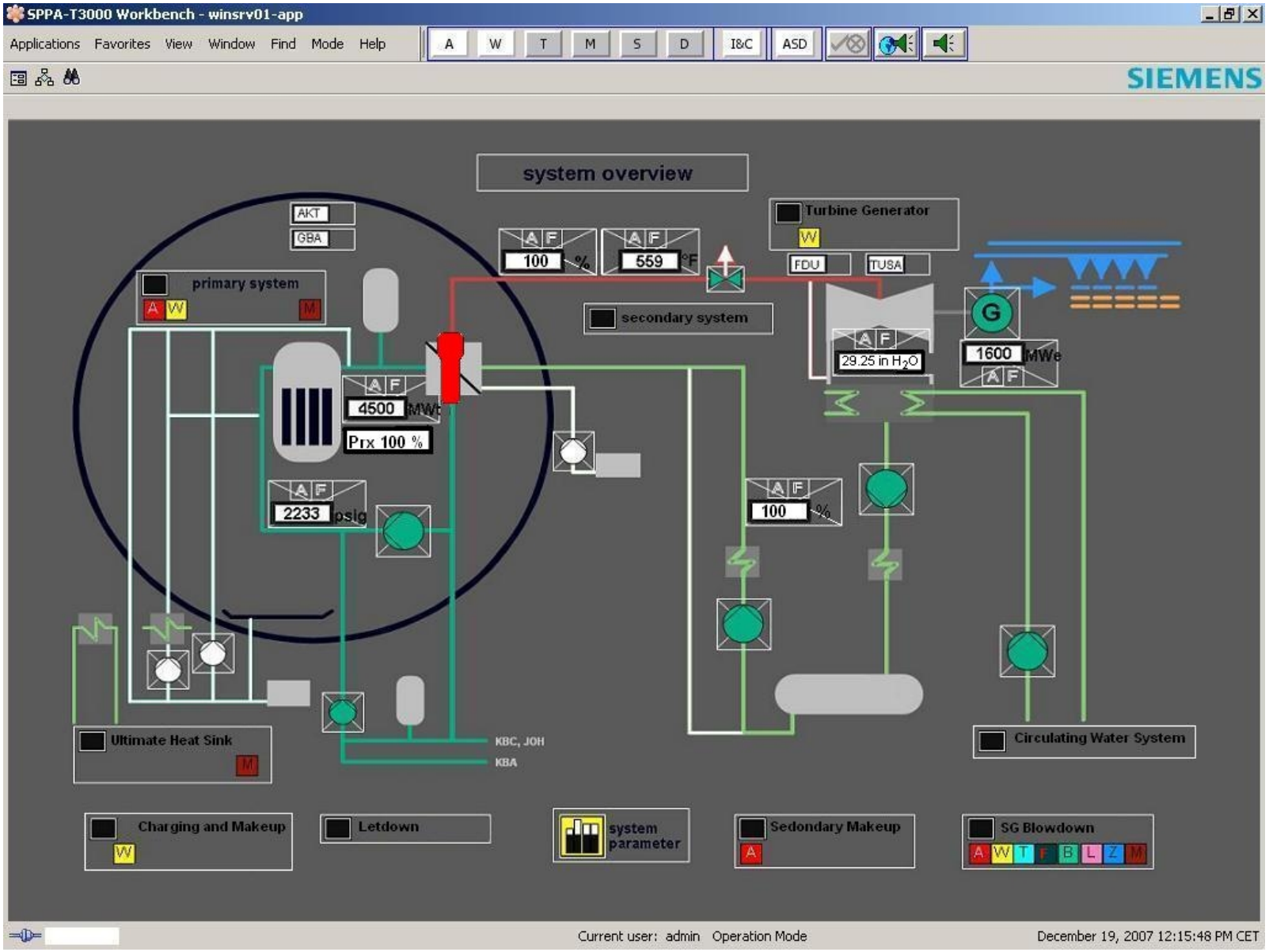
CBP Concept for the U.S. EPR

- The U.S. EPR will utilize a CBP system on the Siemens T3000 HMI platform
- CBPs will be used for the following:
  1. Normal Operating
  2. Emergency Operating
  3. Alarm Response
  4. Testing, Maintenance, and Equipment Operation
- The CBPs will be intelligent; real-time plant data is displayed and hyperlinks are provided to related control or procedure screens
- The CBPs will NOT integrate either embedded control (equipment control in the CBP) or automation (i.e. multi-procedure step execution)
- The CBPs will include intelligent computer review capabilities

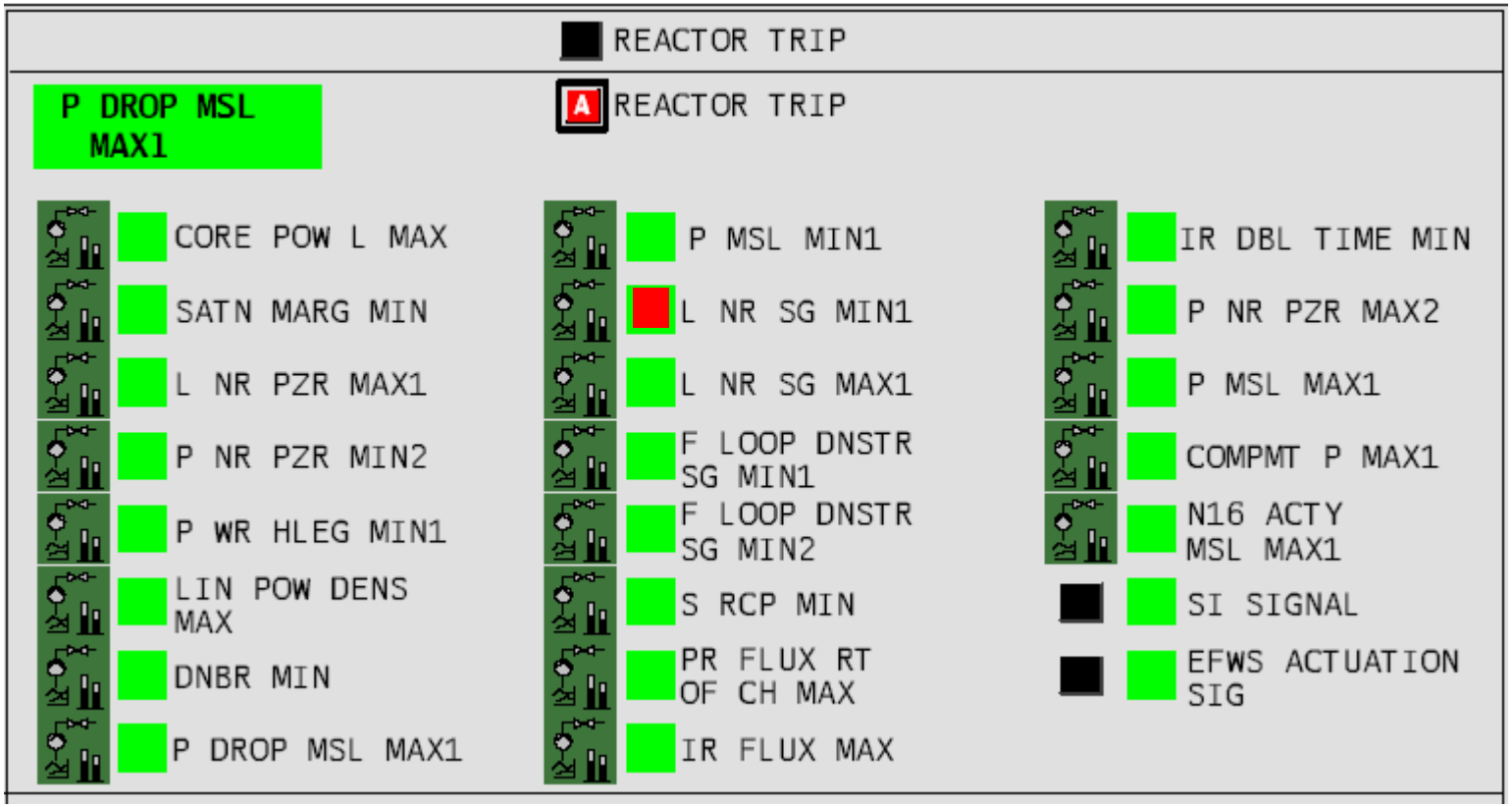
Siemens T3000

- Fully integrated DCS and HMI platform
- T3000 has significant improvements in HMI over OM690 (T2000)
- Current version includes CBP creation tools
- CBPs are created in XML (EXtensible Markup Language)
- XML is a document description language, much like SGML or HTML
- Easy to update by replacing a file on the server
- AREVA is currently developing procedure requirement specifications for the T3000

T3000 – Procedure Scenario



Alarm from PS - Reactor Trip



EOP 21.3

Low Steam Generator Level Reactor Trip Version 1.71

Entry Condition

RPS Reactor Limit Requiring Reactor Trip

Set Point Limit

SG Low Level

SG 1 - 20 in. SG 2 - 21 in. SG 3 - 15 in. SG 4 - 18 in.

Immediate Actions

1) Push Both Reactor Trip and DSS Pushbuttons .

2) Verify Reactor Shutdown

2.1) Ensure all Rod are inserted POSITION RCCA MIN

2.2) If Reactor is Shutdown go to step 3), else if Main Feedwater is NOT available , then perform following:

Main Turbine Status

2.2.1) Ensure Main Turbine is Tripped OFF LINE

2.2.2) Initiate Emergency Feedwater

2.3) Maintain primary-to- secondary heat transfer (PSHT)

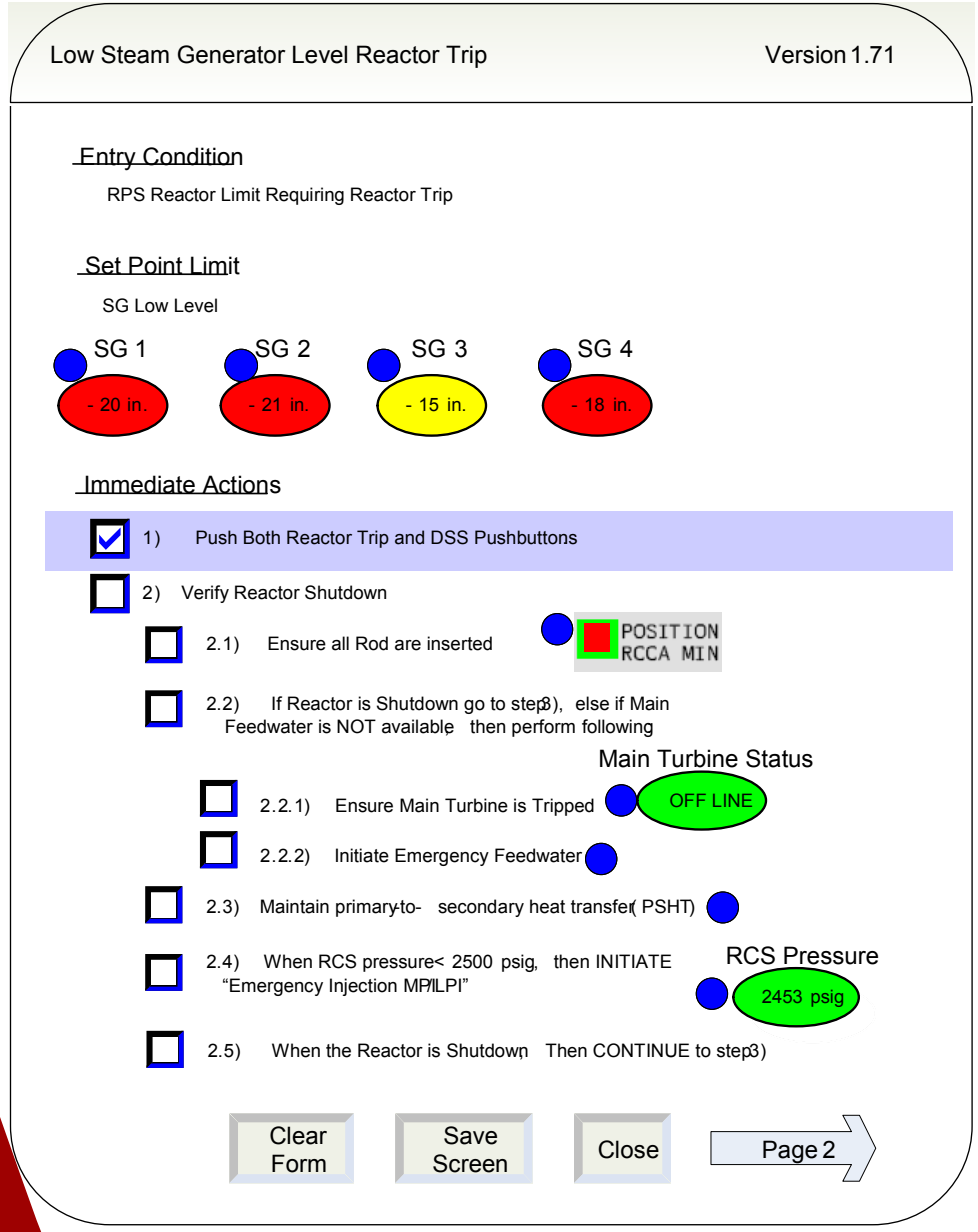
2.4) When RCS pressure < 2500 psig, then INITIATE "Emergency Injection MPI/LPI"

RCS Pressure 2453 psig

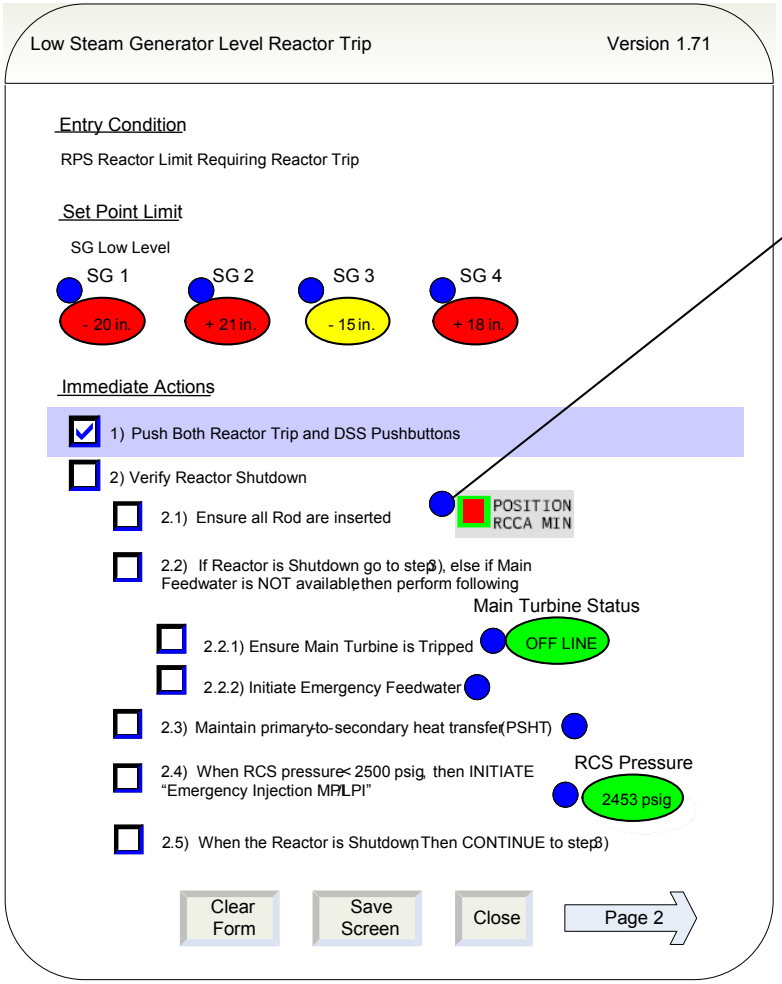
2.5) When the Reactor is Shutdown , Then CONTINUE to step 3)

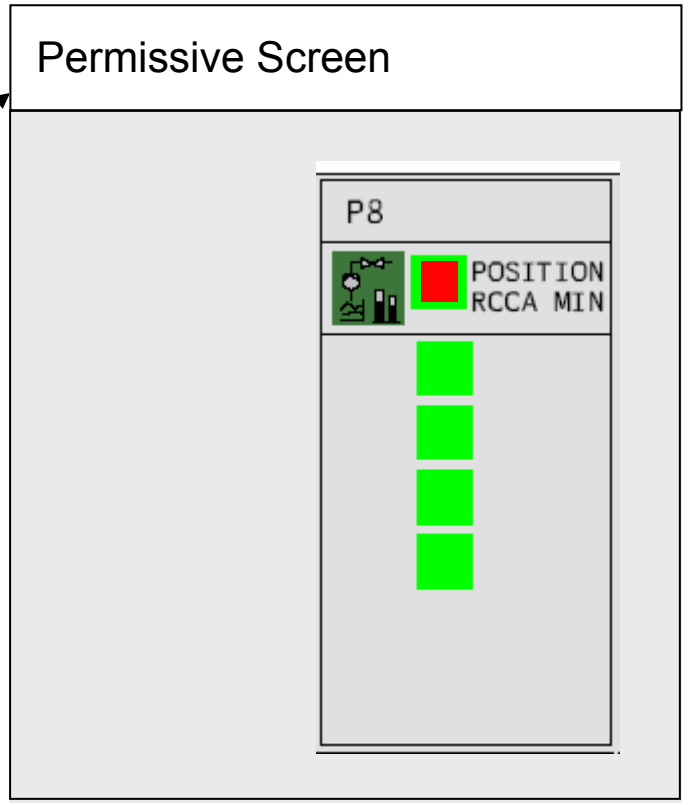
Clear Form | Save Screen | Close | Page 2

Step 1 Complete

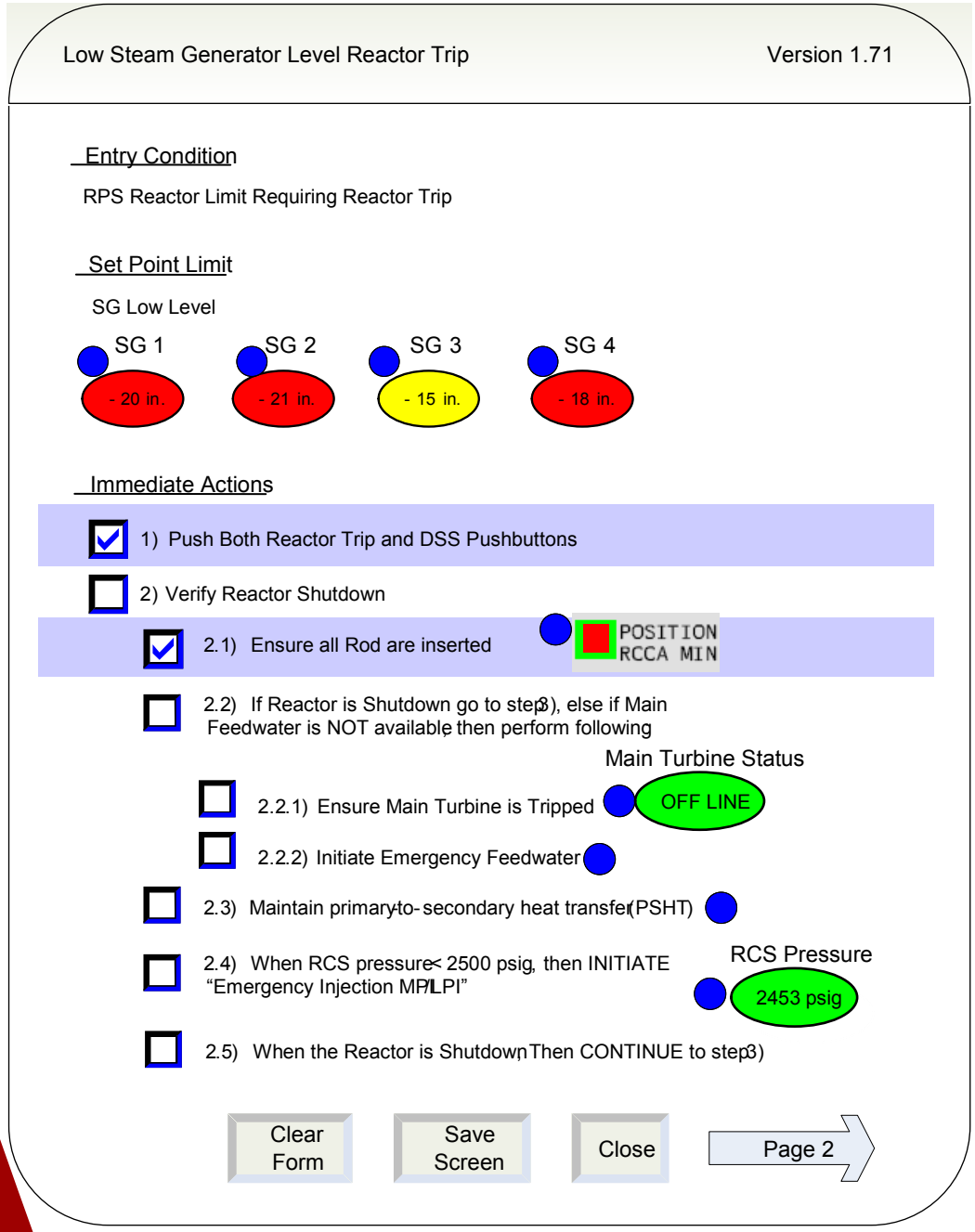


Associate Info. & Control Screen

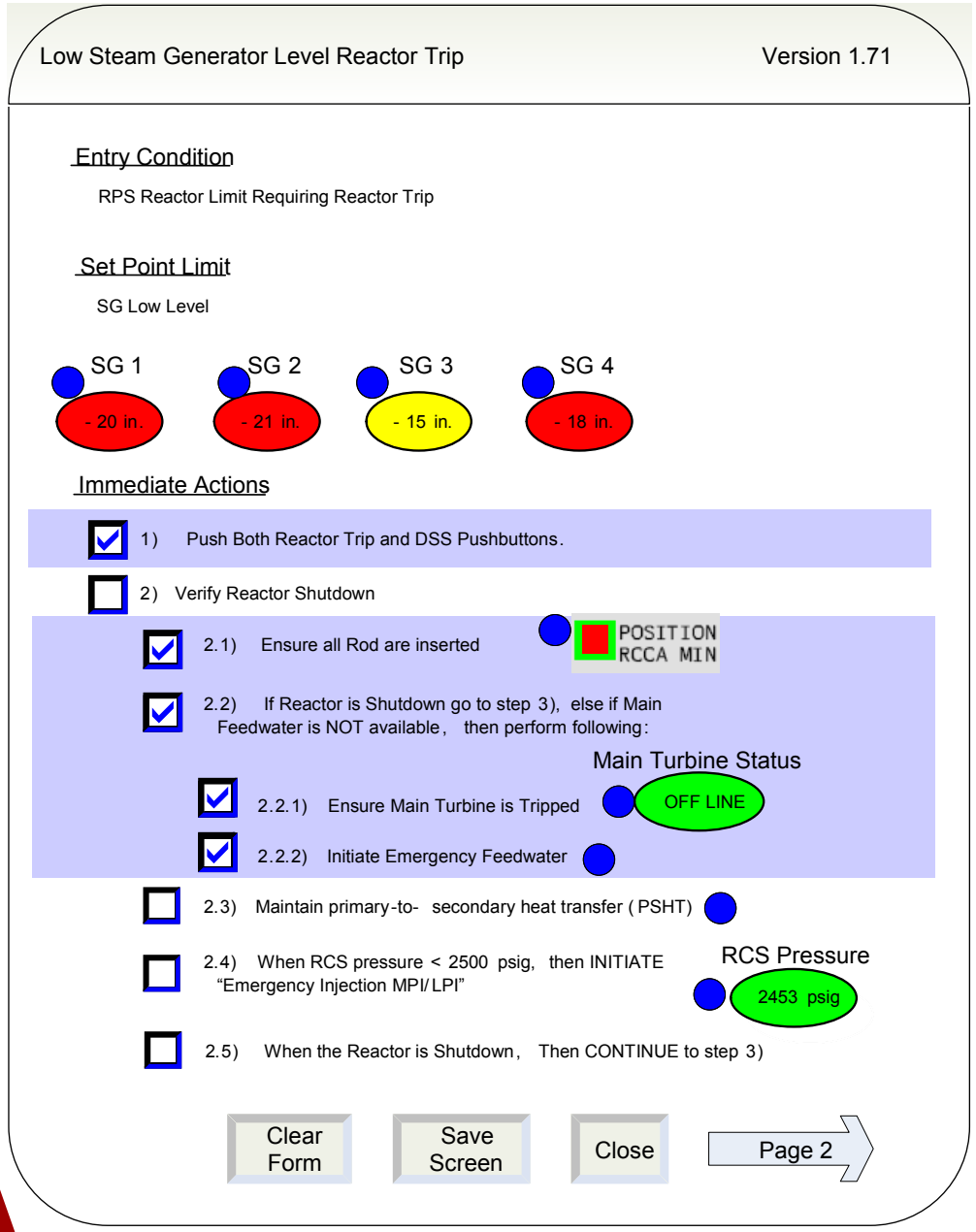




Step 2.1


Low Steam Generator Level Reactor Trip
Version 1.71
Entry Condition
RPS Reactor Limit Requiring Reactor Trip
Set Point Limit
SG Low Level
SG 1
- 20 in.
SG 2
- 21 in.
SG 3
- 15 in.
SG 4
- 18 in.
Immediate Actions
1) Push Both Reactor Trip and DSS Pushbuttons
2) Verify Reactor Shutdown
2.1) Ensure all Rod are inserted
POSITION
RCCA MIN
2.2) If Reactor is Shutdown go to step 3), else if Main Feedwater is NOT available then perform following
Main Turbine Status
2.2.1) Ensure Main Turbine is Tripped
OFF LINE
2.2.2) Initiate Emergency Feedwater
2.3) Maintain primary-to-secondary heat transfer (PSHT)
2.4) When RCS pressure < 2500 psig, then INITIATE "Emergency Injection MP/LPI"
RCS Pressure
2453 psig
2.5) When the Reactor is Shutdown, Then CONTINUE to step 3)
Clear Form
Save Screen
Close
Page 2

Step 2.2


Low Steam Generator Level Reactor Trip
Version 1.71
Entry Condition
RPS Reactor Limit Requiring Reactor Trip
Set Point Limit
SG Low Level
SG 1
- 20 in.
SG 2
- 21 in.
SG 3
- 15 in.
SG 4
- 18 in.
Immediate Actions
1) Push Both Reactor Trip and DSS Pushbuttons.
2) Verify Reactor Shutdown
2.1) Ensure all Rod are inserted
POSITION
RCCA MIN
2.2) If Reactor is Shutdown go to step 3), else if Main Feedwater is NOT available, then perform following:
Main Turbine Status
2.2.1) Ensure Main Turbine is Tripped
OFF LINE
2.2.2) Initiate Emergency Feedwater
2.3) Maintain primary-to- secondary heat transfer (PSHT)
2.4) When RCS pressure < 2500 psig, then INITIATE "Emergency Injection MPI/LPI"
RCS Pressure
2453 psig
2.5) When the Reactor is Shutdown, Then CONTINUE to step 3)
Clear Form
Save Screen
Close
Page 2

Moving Forward

- DI&C-ISG.05 recommends "a computer-based procedure system that displays operating procedures should be designed as an integral part of the main control room"
- Industry guidance is necessary to ensure the regulatory review process aligns with the technology being used

Conclusions

- T-3000 is an open system that's versatility will allow it to support next generation of CBP systems
- Areva NP is looking forward to taking this next step in providing state-of-the art tools for the US EPR