

REACTOR PROTECTION AND CONTROL
PROCESS INSTRUMENTATION REPLACEMENT PROJECT AT
DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2

TEST PROGRAM SUMMARY

REPORT NO. 2985-BJB-01, REV 0

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Reactor Protection and Control
Process Instrumentation Replacement Project at
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Scope:

The Test Program consists of Factory Acceptance Tests (FATs), Integration Tests, Installation Tests, Surveillance Tests and Time Response Tests for the Reactor Protection and Control Process Instrumentation Replacement Project for Donald C. Cook Nuclear Plant Units 1 and 2. The overall Test Program described below will ensure the replacement equipment will perform it's intended function within it's prescribed acceptance criteria.

This Test Program does not include the various equipment qualification tests, such as environmental and seismic tests. These qualification tests are detailed elsewhere. Certain inspections are noted in the test summary below. Quality Control and Quality Assurance inspections performed for this project are covered under the project QA program requirements elsewhere.

Overview:

Testing will be performed in hierarchical fashion to ensure that any problems which are found can be resolved before the equipment proceeds to the next phase of the project (Factory Fabrication, Plant Installation, Plant Operation). Pre-installation testing will be done via Factory Acceptance Tests and Integration Tests to ensure the replacement equipment will meet it's required function prior to actual installation. Installation tests will ensure the replacement equipment is installed according to approved design and integrated with their existing plant interfaces, such as sensors, alarms and trip functions, which are not being replaced. Post-installation Surveillance and Time Response tests will be performed to ensure the replacement equipment will meet the plant Technical Specification requirements for system operability. The replacement equipment must satisfactorily pass all of it's required tests and all problems satisfactorily resolved before the system is declared operable.

Summary Discussion:

The Test Program consists of Factory Acceptance Tests (FATs), Integration Tests, Installation Tests, Surveillance Tests and Time Response Tests.

Factory Acceptance Test (FAT)

Factory Acceptance Tests are pre-installation tests which verify the replacement equipment, including power supplies, interposing

relays, rack wiring, input and output modules and loop configurations, perform their intended function as required by both the replacement vendor and AEP design specifications prior to acceptance for delivery or installation of the equipment.

These tests are written such that a complete history of each test is documented, including a log of any discrepancies found, resolution of these discrepancies, a record of test personnel, test equipment, test setup and configuration. The final factory assembled racks which will be installed at the plant are subjected to the tests.

Temporary 120vac power is supplied to the permanent rack power supplies. The permanent rack power supplies are used to power all instrument loops. Field inputs to the rack analog input modules and output loads from the rack analog output modules are simulated using test equipment which mimic actual field conditions. The loops are configured using the controlled configuration documents which will be used for the actual installation. All inputs and outputs are tested and the overall loop configuration is verified. Dynamic and control algorithm response tests are performed to ensure their response characteristics meet the plant specific requirements. In addition, time response tests will be performed to ensure the replacement equipment will meet the plant specific time response requirements. All rack workmanship, materiel condition and wiring is also verified.

The FAT procedures are meticulously detailed. Their primary purpose is to detect any potential design, equipment or performance problems which would jeopardize plant control or protection systems from performing their intended function. All problems identified will be resolved prior to acceptance of the replacement equipment and commencement of the installation of the replacement equipment in the plant.

Integration Testing

The Integration Tests are pre-installation tests which ensure the Reactor Protection Group instrumentation properly interfaces with Control Group instrumentation and vice versa with no adverse interaction. These tests connect the Reactor Protection racks to the Control Group racks per the design wiring diagrams and simulate various anticipated rack interactions and perturbations, including adverse power failures, instrument groundings or failures.

The primary emphasis of the Integration Tests is to ensure that the Reactor Protection group and the Control group operate together without adverse interaction. Expected results will be

recorded and any unexpected results will be investigated and satisfactorily resolved prior to acceptance of the replacement equipment and commencement of the installation of the replacement equipment in the plant. These tests are written such that a complete history of each test is documented, including a log of any discrepancies found, resolution of these discrepancies, a record of test personnel, test equipment, test setup and configuration.

Installation Testing

Installation Tests are performed to ensure the replacement equipment is properly installed and wired into their permanent plant mounting locations. Most of the replacement equipment will be mounted in existing racks in the control room. Some of the replacement equipment will be panel mounted on the front control panels. Some of the replacement equipment will be mounted in new racks.

Installation tests consist of initial de-energized wire continuity checks, cable meggering and visual inspections to ensure all plant interfaces such as power, grounding, field sensor inputs, trip, alarm and computer outputs are properly connected with the permanent plant equipment. Once initial checks are complete, the equipment is energized, calibrated and functionally tested to ensure all plant interfaces have been properly integrated. Inspection of the equipment installation is done to ensure the equipment is mounted in compliance with the seismically qualified mounting design.

All installation tests must be satisfactorily completed and any problems resolved before the systems can be declared operable or released for Surveillance Testing. Replacement equipment in critical plant systems whose operability is covered by Technical Specifications will not be released or declared operable until their applicable Surveillance and Time Response Tests are complete.

Surveillance Testing

Once the equipment is installed and Installation Testing has been completed with all problems resolved, Surveillance Tests will be performed to ensure all applicable Technical Specification system operability requirements are met. These Surveillance Tests must be satisfactorily completed before the system can be declared operable.

Time Response Testing

Some of the replacement equipment is integral to critical plant

systems which are required to meet specific time response tests per plant Technical Specifications. These Time Response Tests must also be satisfactorily completed before the system can be declared operable.

For Installation, Surveillance and Time Response Tests, specific plant procedures are utilized to perform and document the tests, and to identify and document resolution of all problems.

Conclusion:

The above summary describes the various phases of the overall Test Program. These tests are performed in hierarchial fashion to ensure that any problems which are found can be resolved before the equipment proceeds to the next phase of the project. The tests are performed to ensure proper operation and integration of the replacement equipment in compliance with the vendor and AEP design specifications and plant functional and Technical Specification requirements.

References:

1. Foxboro Factory Acceptance Test Procedure for the Upgrade of the Reactor Protection Process Instrumentation - TP-150, Draft Rev 2
2. Electrical Installation and Checkout Procedure - 12 IHP 6030 IMP.59

Various Surveillance/Maintenance Test Procedures

3. DT/Tavg Protection Set I Calibration **2 IHP 6030 IMP.194
4. Reactor Coolant Flow Protection Set I Calibration **2 IHP 6030 IMP.199
5. Steam Generator Level Protection Set I Calibration **2 IHP 6030 IMP.204
6. Pressurizer Level Protection Set I Calibration **2 IHP 6030 IMP.208
7. Steam Generator 1 & 2 Mismatch Protection Set I Calibration **2 IHP 6030 IMP.211
8. Steam Generator 3 & 4 Mismatch Protection Set I Calibration **2 IHP 6030 IMP.212
9. Pressurizer Pressure Protection Set I Calibration **2 IHP 6030 IMP.215

10. Lower Containment Pressure Protection Set I Calibration **
THP 6030 IMP.219
11. Turbine Impulse Chamber Pressure Protection Set I
Calibration **2 IHP 6030 IMP.223
12. Reactor Coolant Wide Range Temperature Calibration **2 IHP
6030 IMP.256
13. Auxiliary Feedwater To Steam Generator #1 Flow Indication
Calibration **2 IHP 6030 IMP.265
14. Auxiliary Feedwater To Steam Generator #3 Flow Indication
Calibration **2 IHP 6030 IMP.267
15. Steam Generator 1 & 2 Mismatch Protection Set I Transmitter
Calibration **2 IHP 6030 IMP.400
16. Steam Generator 3 & 4 Mismatch Protection Set I Transmitter
Calibration **2 IHP 6030 IMP.401
17. Reactor Coolant Flow Protection Set I Surveillance Test
(Monthly) **2 IHP 4030 STP.101
18. Overtemperature and Overpower Protection Set I Surveillance
Test (Monthly) **2 IHP 4030 STP.104
19. Pressurizer Level Protection Set I Surveillance Test
(Monthly) **2 IHP 4030 STP.108
20. Pressurizer Pressure Protection Set I Surveillance Test
(Monthly) **2 IHP 4030 STP.111
21. Steam Generator Water Level Protection Set I Surveillance
Test (Monthly) **2 IHP 4030 STP.115
22. Steam Generator 1&2 Mismatch Protection Set I Surveillance
Test (Monthly) **2 IHP 4030 STP.119
23. Steam Generator 3&4 Mismatch Protection Set I Surveillance
Test (Monthly) **2 IHP 4030 STP.120
24. Containment Pressure Protection SET I Surveillance Test
(Monthly) **2 IHP 4030 STP.146
25. Reactor Protection & Engineered Safeguards System Time
Response Train A Surveillance Test Procedures - **2 IHP 4030
STP.100A

