

CONTROL ROOM HABITABILITY STUDY - FINDINGS AND RECOMMENDATIONS

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Abstract

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The Advisory Committee on Reactor Safeguards (ACRS) has raised a number of concerns related to control room habitability and has recommended actions which they believe could alleviate these concerns. As a result of the ACRS's concerns, the U.S. Nuclear Regulatory Commission's (NRC) Office of Nuclear Reactor Regulation (NRR) in conjunction with the Offices of Research and Inspection and Enforcement, and the NRC regional offices, embarked upon a program to reevaluate Control Room Habitability.

Argonne National Laboratory was contracted by the NRC to perform a Control Room Habitability Study on twelve licensed power reactors. The plants selected for the study were chosen based upon architect engineer, nuclear steam system supplier, utility, and plant location.

Participants in the study, review the plant design as contained in the Updated Safety Analysis Report, Technical Specifications, Three Mile Island action item III.D.3.4 submittal on Control Room Habitability, NRC staff evaluation of the III.D.3.4 submittal, appropriate plant operating procedures, system drawings, and significant Licensee Event Reports on Loss of Cooling to the Control Room Envelope. A two-day visit is then made to the plant to determine if the as-built systems are built, operated, and surveillance performed as described in the documentation reviewed prior to the visit.

The major findings of this study are included in this report along with generic recommendations of the review team that apply to control room HVAC systems. Although the study is not complete, at the time of publication of this report, the results obtained to date should be useful to persons responsible for Control Room Habitability in evaluating their own systems.

I. Background

As a result of concerns on Control Room Habitability by the Advisory Committee on Reactor Safeguards (ACRS),<sup>(1)</sup> Argonne National Laboratory was contracted by the Nuclear Regulatory Commission (NRC) in January 1984 to assist in conducting a survey of Licensee Control Room Habitability practices. The initial survey included review of three plants, a near-term operating licensee (NTOL) plant, and two plants with operating licenses. The review of these plants was primarily aimed at determining the degree to which the as-built system conformed to the systems described in the updated Final Safety Analysis Reports (FSAR's), current existing NRC criteria, and proposed new NRC criteria. In the process of the review, preoperational test procedures and current methods of performing surveillance testing was

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also examined. A complete report of this survey can be found in NUREG/CR-41 91, ANL-85-13, "Survey of Licensee Control Room Habitability Practices."

As a result of the initial study of the three plants, the following findings were reported to the ACRS. (2)

- (1) The updated FSAR's for the operating plants do not reflect the actual as-built systems, nor do they accurately describe how the systems are operated. The obsolescence of the FSAR's appears to be due to inadequate or untimely configuration control.

Modifications to both hardware and the methods of operating the systems have been made without complete configuration control. Areas lacking in configuration control include plant procedures, training material, and plant drawings.

- (2) The Technical Specifications, specifically the surveillance requirements, are poorly understood, and in some cases, inadequate at both operating plants.
- (3) Preoperational testing does not adequately demonstrate system design margins or the consequences of system failure.

At both operating plants, operational testing was designed to confirm that the Technical Specification surveillance requirements were met. . . . these requirements are poorly understood and thus the operational tests are often deficient.

- (4) Maintenance . . . was found to be less than desirable at the plant with the more complex and congested system.
- (5) At both operating plants significant quantities of air flow were observed to be passing through the ESF filters, although the filters were not in service and were intended to be in an isolated condition.
- (6) At all plants surveyed the potential for ESF bypass leakage existed.

Upon completion of the initial study, the Argonne review team reported to the subcommittee on Nuclear Plant Ventilation Systems of the ACRS. It was felt that findings based on the review of two operating nuclear plants was inconclusive. The ACRS subcommittee recommended that 12 additional plants be surveyed to determine if the above findings applied to a significant number of operating plants.

Argonne National Laboratory was contracted by the NRC to conduct a survey of 12 additional operating plants. The plants selected for the study were chosen based upon architect engineer, nuclear steam systems supplier, utility, and plant location by NRC regions. The factors used in the plant selection have provided a good cross section of HVAC system design for the study. Several plants were included in the study because they had experienced a loss of cooling to the control room envelope event or significant toxic gas challenges.

## II. Conduct of Survey

The plant reviews are conducted by a 2-3 person team plus NRC representatives from NRR in Bethesda, Maryland and inspection and enforcement personnel from the region in which the plant being surveyed is located. Typically, a preliminary visit is made to the plant to explain the purpose of the visit and to obtain related plant procedures, Technical Specifications, FSAR chapters, plant drawings and significant Licensee Event Reports on "Loss of Cooling to the Control Room Envelope." The review team then studies these documents, as well as the III.D.3.4 submittal and NRC staff review of the submittal which are provided by NRC. Plant drawings are reviewed and a list of test ports is made up. The utility is then requested to install test ports so that flow measurements can be obtained to evaluate the performance of the system. The III.D.3.4 submittal is evaluated to determine if the NRC staff reviews may have had any misconceptions about the design of the as-built system (i.e., the utility taking credit for redundant isolation dampers when there is only one, unfiltered air inleakage to the control room used in exposure calculations not in agreement with the control room design leakage, etc.). The Technical Specifications are compared to the FSAR to determine if all items required by the Safety Analysis are incorporated into the Technical Specifications. Plant procedures are reviewed to determine that the plant is operated and surveillance is performed to meet the intent of the Technical Specifications. As the document review progresses, a list of questions is generated and incorporated into a plant visit checklist. The checklist is sent to the utility a week to ten days prior to a second visit to the plant by the review team. The second visit takes two to three days.

During the plant visit, the questions incorporated into the checklist are discussed with plant personnel. The control room HVAC system flow measurements are obtained with the system operating in Normal and Emergency modes of operation. In some instances surveillance tests are observed and data taken during the test.

## III. Findings and Recommendation of Plants Surveyed

The findings listed are from six (of the additional 12) plants visited to date. Once the survey has been completed, it is anticipated that a complete report will be issued as a NUREG/CR.

The following list of findings and review team recommendations includes findings that were identified at two or more of the plants surveyed. Due to the variations in system designs, there are many findings that are specific to each plant surveyed. A complete list of findings for each plant will be included in the NUREG/CR. Review team recommendations will undergo NRC management review process. Due consideration will be given to the cost and benefit of review team recommendations. An asterisk (\*) denotes plant affected by the finding.

FINDINGS

PLANTS AFFECTED

A B C D E F

1. The FSAR and system descriptions did not give adequate detail on how the system is operated.

\* \* \* \* \*

A review of the FSAR and systems descriptions should be conducted and a concerted effort be made to update these documents.

2. The general condition of the CR-HVAC equipment indicated a need to improve attention to detail.

\* \* \* \* \*

Missing screws and bolts should be replaced. Broken fabric should be replaced in the expansion joints.

3. Doors on the control room envelope boundary are fire-rated doors, but are not equipped with seals to minimize air leakage across the boundary.

\* \* \* \* \*

Install or replace door seals.

4. The safety-grade cooling system has marginal capacity or is not properly tested.

\* \* \* \* \*

Upgrade the cooling capacity of the safety-grade system or revise surveillance procedures to demonstrate cooling capacity.

5. The temperature required for the control environment is either too high for instrumentation requirements or is not specified in the technical specifications.

\* \* # \* \* \*

Instrumentation qualification temperatures should be reviewed and appropriate limits incorporated into the technical specifications.

6. Operability of CR-HVAC isolation valves is not included in the technical specifications surveillance requirements.

\* \* #

Revise technical specifications surveillance requirements to include operability checks for the isolation valves.

#. Plant B does not have an approved technical specification for Control Room Habitability.

FINDINGS

PLANTS AFFECTED  
A B C D E F

7. Technical specifications do not list equipment required to consider the system operable. The omission of an equipment list allows too much latitude in deciding if the limiting conditions for operation (LCO's) has been met.

Revise technical specification to include specific equipment for which the requirement is applicable.

\* \* # \* \* \*

8. Limiting conditions for operation of radiation monitors associated with the control room HVAC system are not included in the technical specifications.

Revise technical specifications to include radiation monitors associated with the CR-HVAC system in limiting conditions for operation.

\* # \*

9. Laboratory analysis for methyl iodine removal efficiency is not conducted at the proper temperature and relative humidity conditions.

The laboratory tests should be conducted at 30° C @ 70% R.H (95% R.H. if heaters are not installed in filter train) in accordance with ASTM D 3803-79, "Radioiodine Testing of Nuclear Grade Gas-Phase Adsorbers."

\* + \* \* \*

10. The minimum efficiency required to pass the laboratory test for methyl iodine is specified in the technical specification at a lower value than the value used to calculate radiation exposure in the plant safety analysis.

Revise technical specification to agree with the plant safety analysis or revise the radiation dose calculations in the safety analysis.

\* + \* \* \*

11. Air flow was measured through the charcoal adsorber even though the unit was isolated.

Surveillance should be increased on filter train isolation dampers to ensure they are closing properly.

\* \* + N/M \* \*

# Plant B does not have an approved technical specification for Control Room Habitability.

+ Plant B does not have a charcoal adsorber.

N/M Flow was not measured.

FINDINGS

PLANTS AFFECTED  
A B C D E F

- |     |                                                                                                                                                                                                                     |   |   |   |   |   |   |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|
| 12. | Unfiltered-air inleakage to the control room envelope is higher than assumed in the safety analysis.                                                                                                                | * | * | * | * | * | * |
|     | Every reasonable effort should be made to reduce unfiltered-air inleakage. If the values assumed in the safety analysis cannot be achieved, the radiation exposure should be reevaluated using as-found conditions. |   |   |   |   |   |   |
| 13. | Loss of cooling events have occurred in the CR-HVAC system.                                                                                                                                                         | * | * |   |   |   | * |
|     | Corrective action was taken by each licensee.                                                                                                                                                                       |   |   |   |   |   |   |
| 14. | The NUREG 0737 III.D.3.4 submittal to the NRC from the licensee is not in agreement with as-found conditions in the plant.                                                                                          | * | * | * | * | * | * |
|     | The licensee should update the III.D.3.4 submittal and/or modify procedures, technical specifications, safety analysis and system components as necessary to comply with NUREG 0737.                                |   |   |   |   |   |   |
| 15. | Licensee personnel do <u>not</u> have a good understanding of how the CR-HVAC system operates or why the system is necessary from a safe-guards point of view.                                                      | * | * | * | * | * |   |
|     | Licensee personnel should become familiar with regulatory guidelines and requirements for the Control Room Habitability systems.                                                                                    |   |   |   |   |   |   |
| 16. | Bypass test frequency and/or limits are not properly stated in the technical specifications.                                                                                                                        | * | + | * |   |   | * |
|     | Revise technical specifications and/or plant surveillance procedures.                                                                                                                                               |   |   |   |   |   |   |
| 17. | Design flow rates are not specified in technical specification surveillance requirements.                                                                                                                           | * |   |   | # |   |   |
|     | Revise technical specifications to include the design flow rates for safety-related fans.                                                                                                                           |   |   |   |   |   |   |

# Plant B does not have an approved technical specification for Control Room Habitability.

+ Plant B does not have a charcoal adsorber.

FINDINGS

PLANTS AFFECTED  
A B C D E F

18. There is no technical specification limit for maintaining a positive pressure in the control room envelope.

\* # \* \*

Technical specifications should be revised to include a pressurization test. Surveillance procedures should also be written to perform the test.

19. Action required by technical specification in seven days following a loss of equipment which causes an LCO to not be met is inappropriate for systems that do not have redundant trains.

\* #

Revise LCO statements to require action in 24 hours instead of seven days.

- # Plant B does not have an approved technical specification for Control Room Habitability.  
+ Plant B does not have a charcoal adsorber.

IV. Conclusions

The plants reviewed to date have confirmed the findings of the initial survey.

The review team found disagreement with the system descriptions in the FSAR and the actual as-built systems in five of the six plants surveyed.

The Technical Specification for laboratory testing of charcoal is specified at the appropriate test condition of 30°C at only one of the plants surveyed.

The Technical Specification for control room temperature is either set too high or does not exist in all plants surveyed.

The emergency air conditioning heat sinks are not adequately tested at five of the six plants visited.

Technical Specifications are not written clearly enough to determine what components the Specifications apply to in five of the six plants surveyed. One plant did not have a Technical Specification but they were in the process of writing one.

Flow was detected in three isolated charcoal adsorbers which utilize the normal system supply and recirculation fans as part of the emergency filtration system. Two plants surveyed has an emergency filtration system that is completely separated from the normal system. One plant did not have an emergency filtration system.

The control room HVAC systems are, in general, a low priority system and in some cases their function is not fully understood by the system engineers assigned to them. Only one utility surveyed to date has a staff that understands this system. The systems are generally not designed so that surveillance can be performed to completely evaluate the operation of the system. Preoperational testing generally verifies proper flow through fans, filters, and distribution to each room. These tests do not verify where the air is coming from. When a system is designed to have 3200 cfm flow through the emergency filter train with 150 cfm of the 3200 cfm from outside air, system evaluations should be able to determine that this condition exists. If the outside air being supplied to the system is significantly higher than design, the thyroid dose is likely to exceed the GDC-19 limit. Future system designs and system redesigns should take into consideration the need for test ports to properly evaluate the total system performance and not just that of individual system components.

#### References

1. Hayes, J. J., D. R. Muller, and W. P. Gammill, "NRC Study of Control Room Habitability," Proc. 18th DOE Nuclear Airborne Waste Management and Air Cleaning Conference, CONF-840806, Vol. I, p. 163-164 (1985).
2. Boland, J. F., R. L. Brookshier, W. F. Danielson, J. W. Driscoll, E. D. Graham, R. J. McConnell and V. N. Thompson, "Survey of Licensee Control Room Habitability Practices;" Report NUREG/GR-4191, ANL-85-13, Argonne National Laboratory-West, Idaho Falls, ID 83403-2528 (April 1985).

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