

TENNESSEE VALLEY AUTHORITY

NUCLEAR SAFETY REVIEW STAFF

NSRS INVESTIGATION REPORT NO. I-86-101-SQN

SUBJECT INSTALLATION OF CONAX CONNECTORS

DATES OF INVESTIGATION: FEBRUARY 10-13, 1986

INVESTIGATOR:

N. T. Henrich
N. T. HENRICH

2/25/86
DATE

REVIEWED BY:

L. E. Brock
L. E. BROCK

2/26/86
DATE

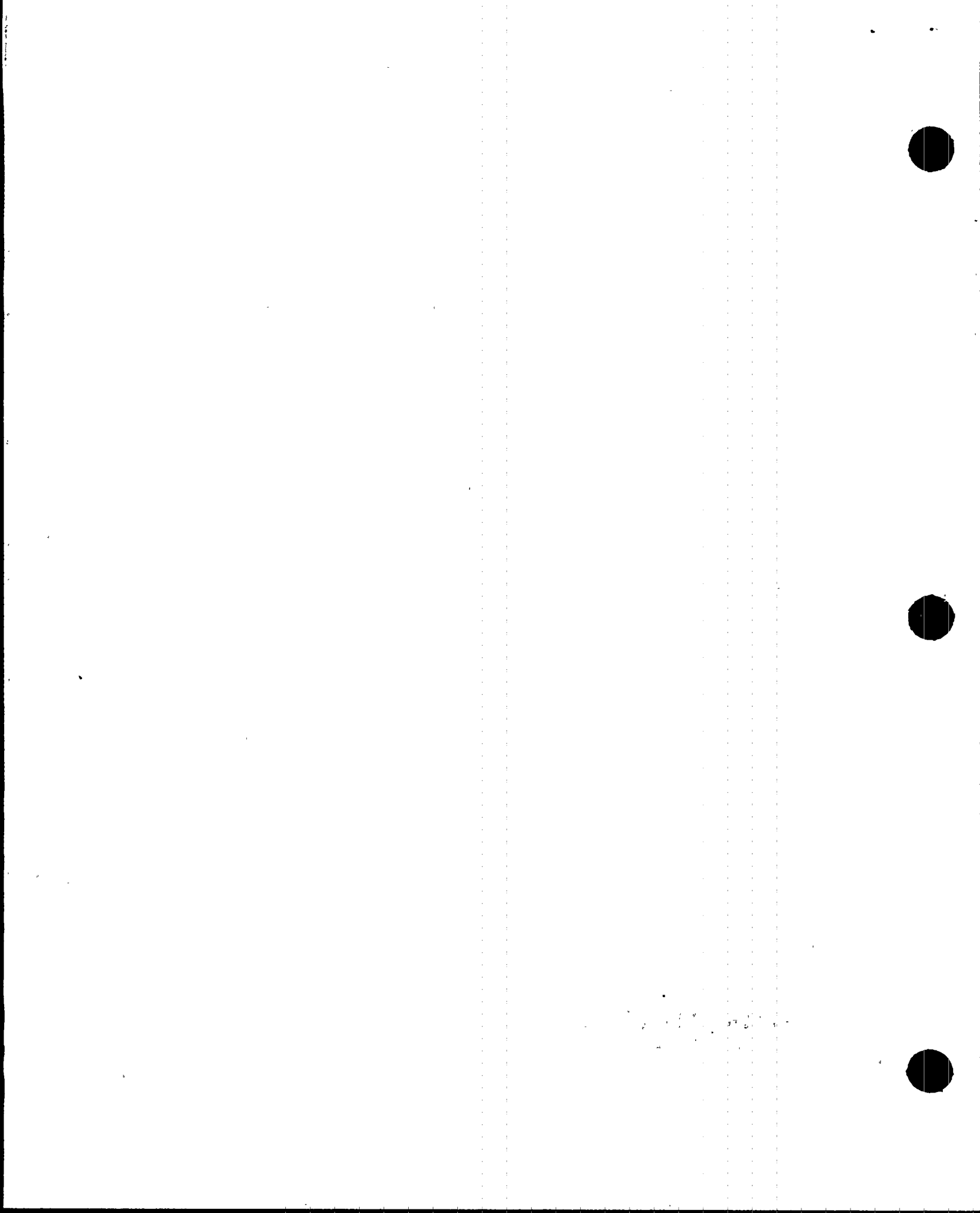
APPROVED BY:

W. D. Stevens
W. D. STEVENS

2/27/86
DATE

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I. BACKGROUND

A Nuclear Safety Review Staff (NSRS) investigation was conducted to determine the validity of an expressed employee concern as received by the Quality Technology Company (QTC)/Employee Response Team (ERT). The concern of record, as summarized on the Employee Concern Assignment Request Form from QTC and identified as XX-85-122-020, stated:

Bellefonte: Human Factors engineering and/or Reviews have not been implemented for control panels and stations. CI expressed that this is a violation of NUREG-0700. CI further stated that there are too many poor engineering practices in this area. CI has no further information. Anonymous concern via letter.

Identical Browns Ferry and Sequoyah Employee Concerns (XX-85-122-022 and XX-85-122-020, respectively) have been identified. These concerns have been addressed by separate NSRS investigation reports.

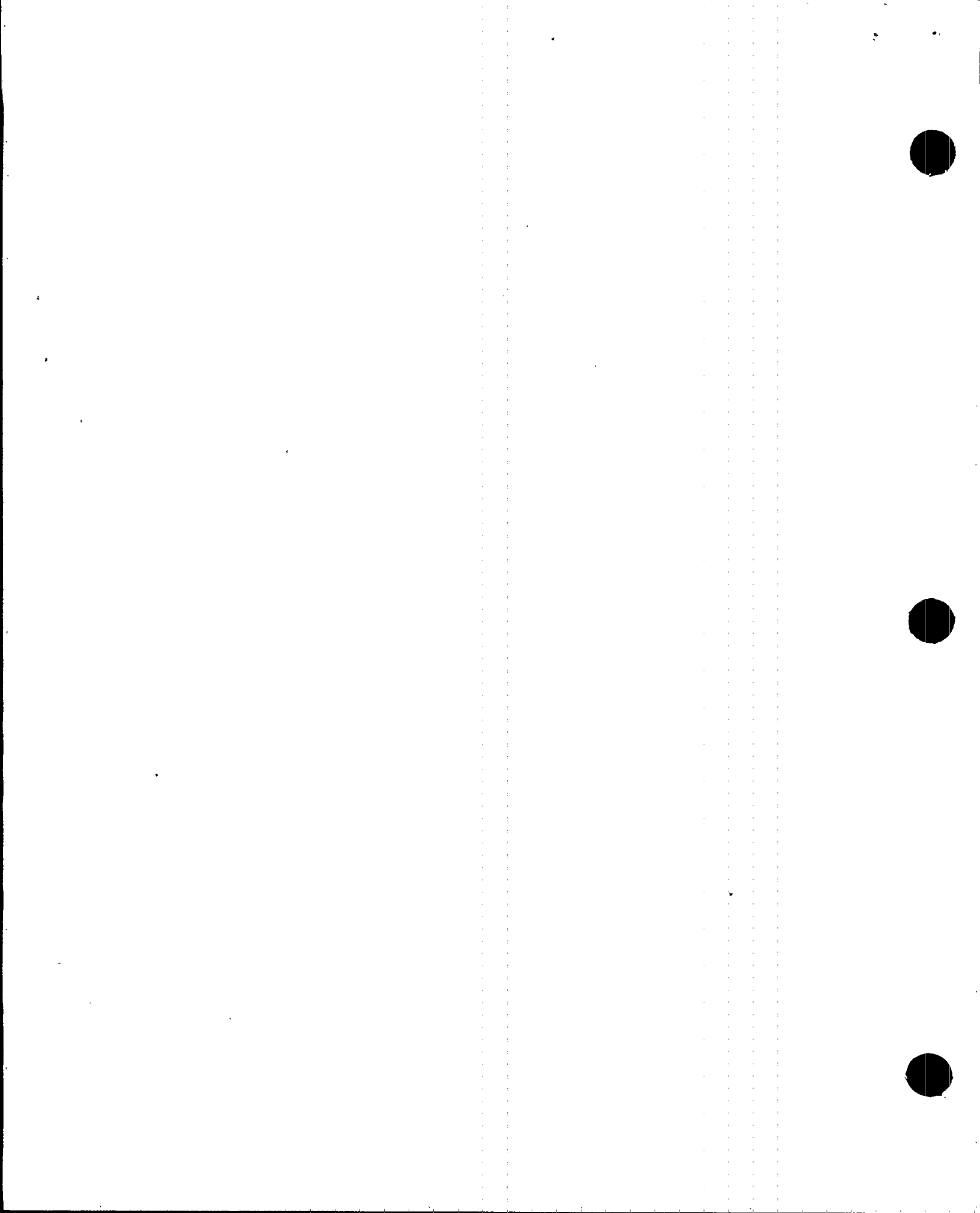
II. SCOPE

- A. The scope of this investigation was determined from the stated concern of record to be that of two specific issues requiring investigation:
1. The BLN Human Factors Control Room Design Review specified in NUREG-0700 has not been implemented.
 2. A significant number of poor engineering practices exists in the application of human engineering principles to the BLN control panels.
- B. To accomplish this investigation, a review of regulatory requirements and TVA commitments for conducting the control room design review (CRDR) was conducted. This included applicable regulatory documents and the TVA CRDR program plan. Interviews with individuals cognizant of BLN CRDR activities were also conducted to determine the nature and extent of activities in this area. Finally, a review was conducted of TVA engineering procedures which govern the application of human engineering principles in the design, layout, and modification of BLN control room panels.

III. SUMMARY OF FINDINGS

A. Requirements and Commitments

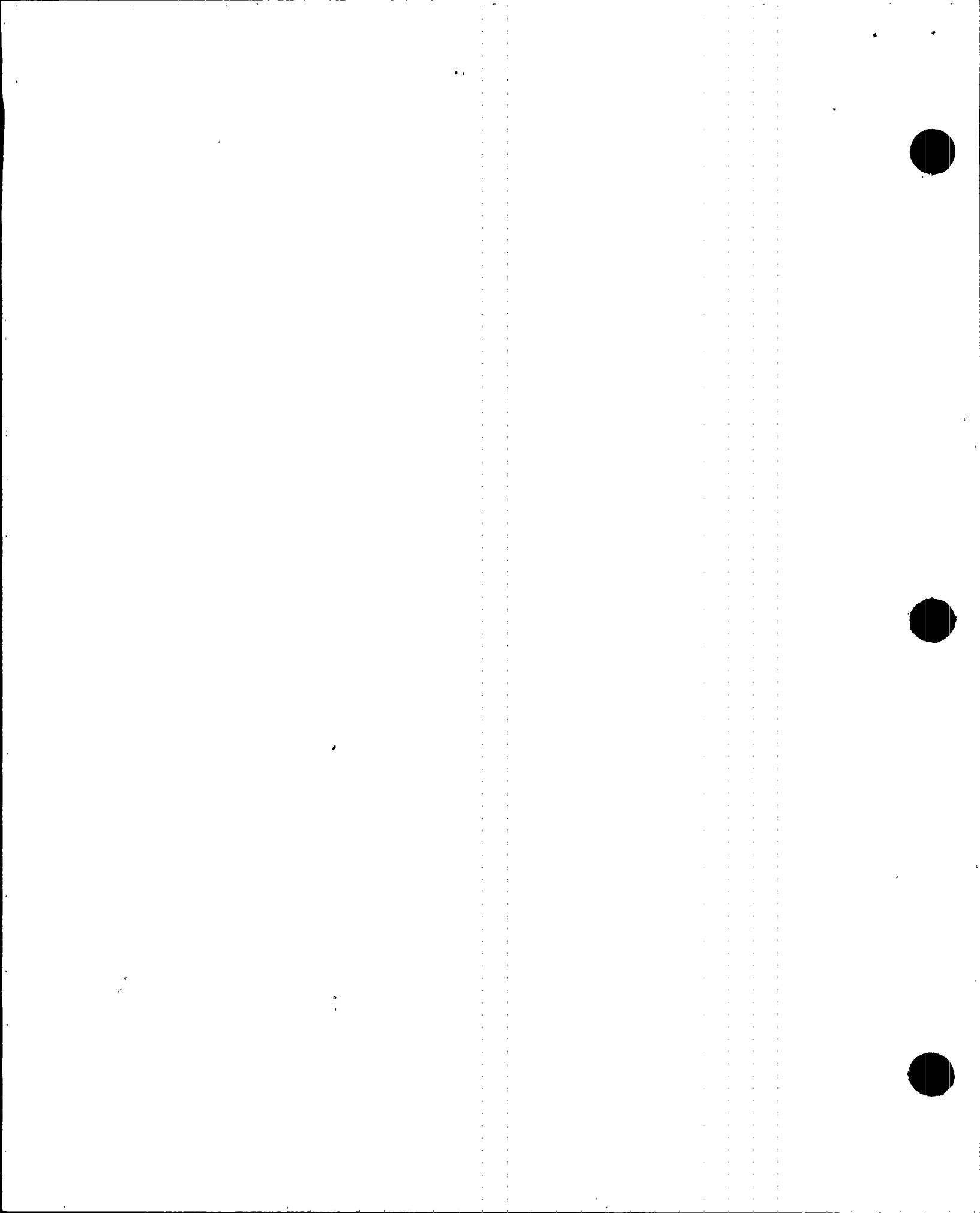
1. NUREG-0737, "Clarification of TMI Action Plan Requirements," Task I.D.1 (Ref. 2)



2. Letter from L. M. Mills (TVA) to E. G. Adensam (NRC) committing BLN to a preliminary design assessment of the Bellefonte main control room and remote shutdown panels (Ref. 4)
3. NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability (Generic Letter 82 - 33)," Section 5 (Ref. 5)
4. Letter from L. M. Mills (TVA) to E. G. Adensam (NRC) committing BLN to a detailed control room design review (Ref. 7)

B. Findings

1. NUREG-0737 (Ref. 2) was transmitted to TVA by reference 1 on October 31, 1980. Task I.D.1 of this NUREG required a detailed control room design review (CRDR) be conducted to identify and correct any human engineering deficiencies (HEDs). This review was to use NRC guidelines on how to conduct a CRDR (NUREG-0700) once they were issued. No implementation schedule was given in Task I.D.1.
2. By reference 3, applicants for operating licenses who would not be able to complete the CRDR prior to licensing were required to conduct a Preliminary Design Assessment (PDA) of their control rooms to identify significant human factors problems and to establish a schedule for correcting them.
3. Based on the BLN construction schedule in 1982, TVA elected to perform a PDA of BLN main control room panels and remote shutdown panels prior to fuel load. Reference 4 documents this commitment to NRC and states TVA's intention to perform a detailed CRDR to supplement the PDA.
4. As a result of changes in BLN fuel load schedule and the identification of potentially significant problems in the BLN control panel layouts by BLN operations personnel, TVA elected to perform the detailed CRDR prior to fuel load and to forego the Preliminary Design Assessment. The BLN CRDR was initiated in November 1982. This activity used the TVA-developed CRDR program plan which was based on requirements set forth in NUREG-0737, NRC guidance provided in NUREG-0700, and a preliminary version of NUREG-0737, Supplement 1 (referred to as SECY-82-111). NRC did not require submittal of the CRDR program plan prior to beginning the review. When NUREG-0737, Supplement 1, was issued by reference 6, no changes to the CRDR program plan were required.
5. NUREG-0737, Supplement 1 (Ref. 6), was transmitted to TVA by D. G. Eisenhut (NRC) on December 17, 1982, by reference 5. Section 5 of this supplement sets forth the following requirements for conducting the CRDR:
 - a. The establishment of a qualified multidisciplinary review team and a review program incorporating accepted human engineering principles.

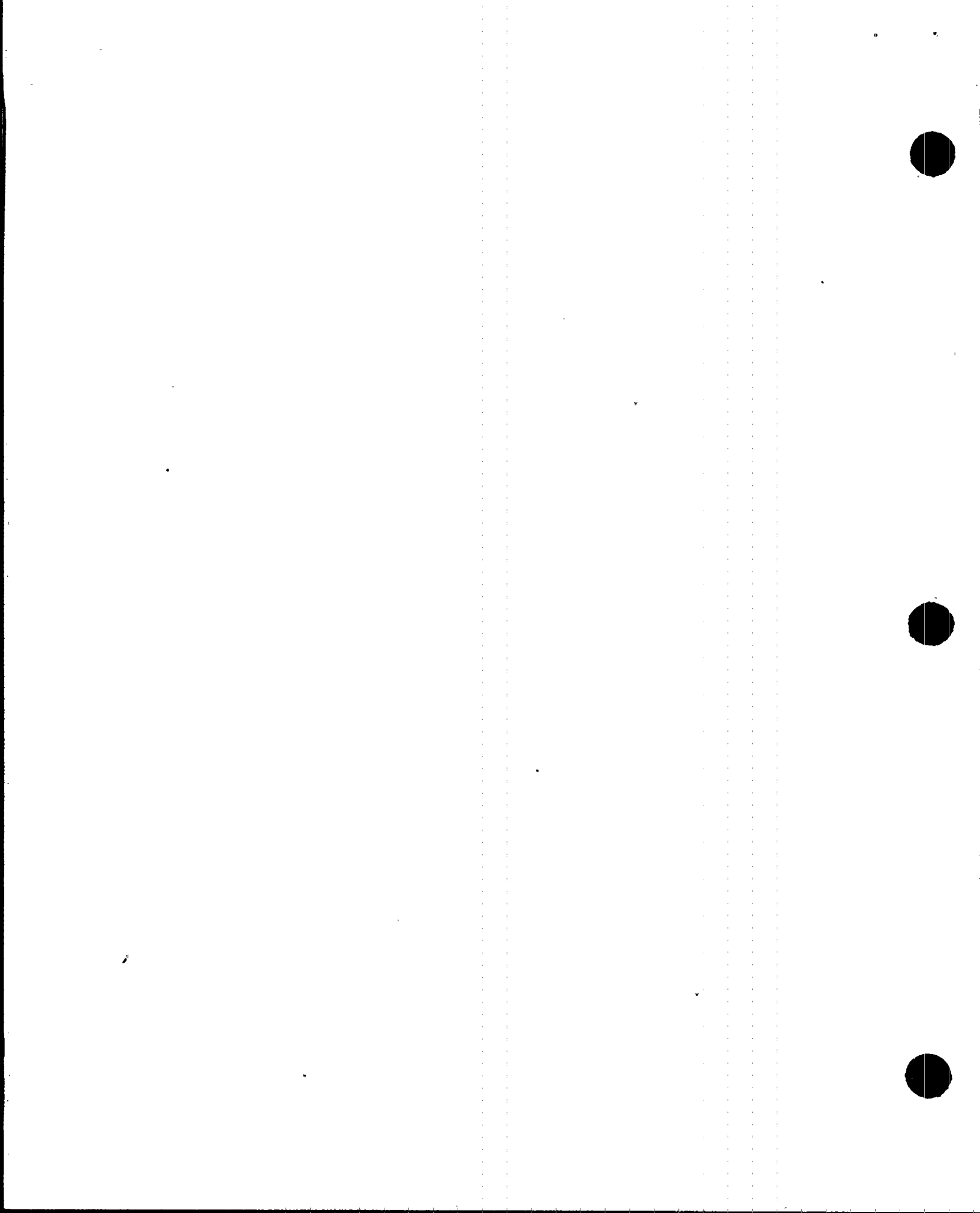


- b. The use of function and task analysis to identify control room operator tasks and information and control requirements during emergency operations.
 - c. A comparison of the display and control requirements with a control room inventory to identify missing displays and controls.
 - d. A control room survey to identify deviations from accepted human factors principles. This survey will include, among other things, an assessment of the control room layout, the usefulness of audible and visual alarm systems, the information recording and recall capability, and the control room environment.
 - e. Assess which human engineering discrepancies are significant and should be corrected. Select design improvements that will correct those discrepancies.
 - f. Verify that each selected design improvement will provide the necessary correction and can be introduced in the control room without creating any unacceptable human engineering discrepancies because of significant contribution to increased risk, unreviewed safety questions, or situations in which a temporary reduction in safety could occur.
 - g. The submittal of a summary report of the completed review outlining proposed control room changes, including their proposed schedules for implementation. The report will also provide a summary justification for human engineering discrepancies with safety significance to be left uncorrected or partially corrected. In addition, NRC required submittal of the CRDR program plan describing how TVA intended to meet these requirements and a proposed schedule for completion of the CRDR.
6. By reference 7, TVA committed to perform a BLN CRDR as required by NUREG-0737, Supplement 1, consistent with a TVA-developed CRDR program plan which TVA committed to submit to NRC by June 1983. Reference 7 also included a commitment to complete BLN CRDR activities prior to fuel load on a schedule contingent on availability of the upgraded emergency operating procedures required by NUREG-0737, Task I.C.1. This commitment superseded that of performing a PDA prior to fuel load.
7. The TVA-developed CRDR program plan is applicable to all nuclear plants. This program plan (Ref. 9a) was transmitted to NRC on June 9, 1983, by reference 10. The TVA CRDR program plan described the main elements of the human engineering efforts to identify and correct deficiencies in design and operation of TVA nuclear power plants. Guidance was provided to TVA personnel



responsible for planning, conducting, and reporting detailed control room design reviews and for recommending appropriate follow-up corrective actions related to the human engineering discrepancies revealed in the detailed review. The program plan also was intended to ensure compliance with pertinent NRC directives and guides, specifically NUREG-0700 (Ref. 8).

8. NUREG-0700 (Ref.8) provided guidance NRC believes should be followed to accomplish a CRDR. It does not define a regulatory requirement. In fact, NUREG-0700 allows alternative approaches, methods, and reporting procedures which may differ from the published guidance provided adequate justification is provided.
9. NRC reviewed the TVA CRDR program plan and provided comments on December 23, 1983 (Ref. 11). TVA responses to these comments were provided to NRC Human Factor Engineering Branch in a meeting in Bethesda, Maryland, on June 14, 1984. TVA responses are documented in reference 12. As a result of this meeting, revisions were made to the TVA CRDR program plan as noted in reference 9b.
10. As of January 14, 1986, the following major CRDR tasks have been completed:
 - Operator questionnaires
 - Operator interviews
 - Operating experience reviews of LERS and SCRAM reports from similar plants
 - Control panel checklist surveys and inventories
 - Preliminary sound, lighting, and heating, ventilation, and air conditioning surveys
 - Assessment of human engineering concerns (HECs) and identification of human engineering discrepancies (HEDs)
 - Development of CRDR Team-recommended corrective action for identified HEDs; this included building a model of the control room panels to aid in the assessment/evaluation of proposed corrective action
 - Submittal of a preliminary action plan to Bellefonte Design Project
11. Bellefonte Design Project committed to implement all CRDR Team-recommended corrective actions which were safety-significant as well as most nonsafety-related recommendations. Design modifications are currently being made to the BLN control room and control room panels to implement these corrections.



12. The following major tasks are yet to be completed:
 - o Task analysis based on plant-specific operating procedures developed from Babcock and Wilcox ATOG guidelines
 - o Assessment of human engineering concerns (HECs) and human engineering discrepancies (HEDs) resulting from task analysis
 - o Submittal of a summary report of the completed review to NRC
13. The CRDR is not a complete redesign of the control room nor is it an ongoing control room design change effort. It is intended to identify and resolve human engineering discrepancies with the existing control room layout/environment in light of lessons learned from the TMI incident and subsequent NRC human factors guidelines issued in 1981.
14. Office of Engineering Procedure OEP-11 (Ref. 13) defines the process by which plant design changes, including control room design changes, are identified, scoped, coordinated, reviewed, and approved. This procedure includes the application of human factor engineering principles in these changes and requires the project engineer to coordinate the design and design review effort with appropriate OE organizations. A checklist is provided in the procedure to aid in this process. All future changes to the BLN control room/control boards will be handled by this procedure.
15. The OE Electrical Engineering Branch, Operator Interface Section, has the responsibility to address the application of human factors engineering (HFE) principles in control room/control board changes. A number of engineering design guides are used in this process. The principal ones are noted below:
 - a. Design Guide E18.1.11 (Ref.14)

This design guide presents principles and techniques of HFE pertinent to designing operator work stations in power generating plants.
 - b. Design Guide E18.1.12 (Ref. 15)

This guide describes methods and techniques of HFE in control console and cabinet design and panel layout. It provides a means for measuring the HFE adequacy of new designs and of modifications of existing designs.



c. Design Guide E18.1.13 (Ref. 16)

This document defines and documents accepted HFE principles and standards to be employed for the design of annunciators and alarm systems.

d. Design Guide E18.1.14 (Ref. 17)

This design guide details the requirements for controls and displays that are integrated into a functional panel design. Criteria that will help the operator identify and operate the controls and displays quickly and efficiently are presented.

e. Design Guide E18.1.15 (Ref. 18)

This design guide contains general HFE requirements for operator interface with computers and computer-driven devices.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

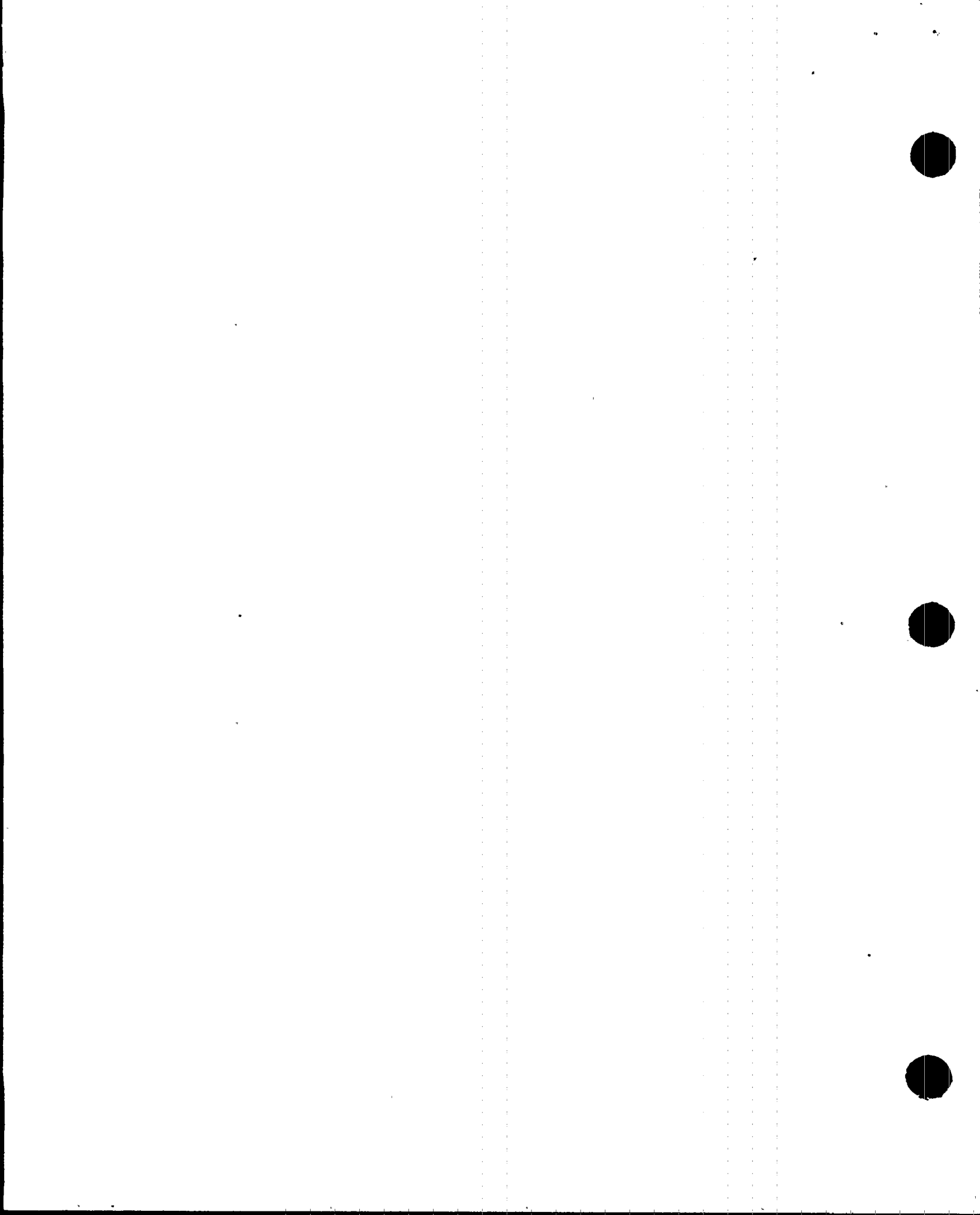
The first issue raised by the concern of record is not substantiated because the required BLN CRDR has been substantially completed.

The second issue raised by the concern of record appears to be substantiated because the BLN CRDR identified a number of significant human engineering discrepancies which led to modifications of the control room panels.

B. Recommendations

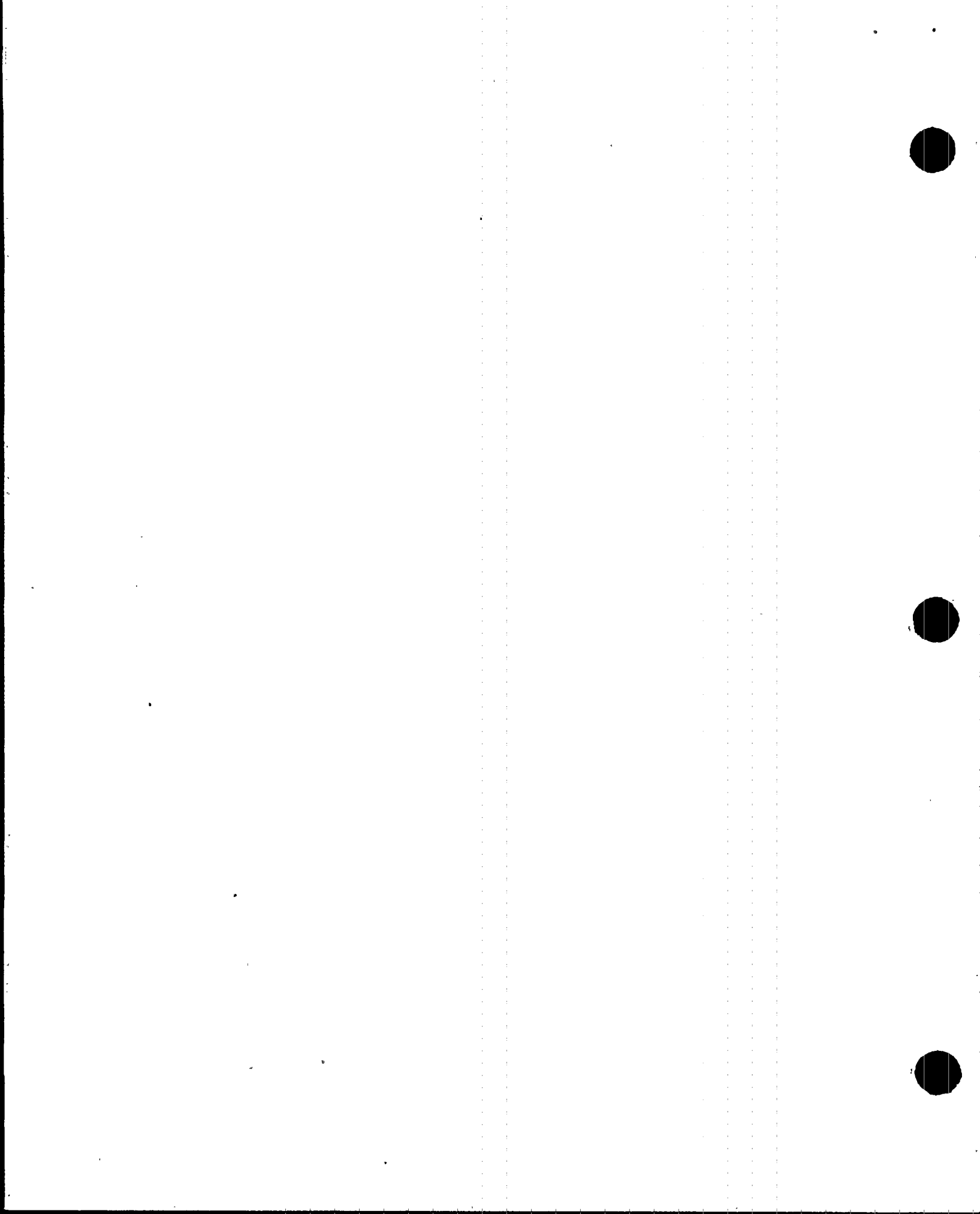
I-85-439-BLN-001, CRDR Follow-up

A copy of the final BLN CRDR summary report of the completed review should be submitted for NSRS review. [P3].



DOCUMENTS REVIEWED IN INVESTIGATION I-85-439-BLN
AND REFERENCES

1. Letter from D. G. Eisenhut (NRC) to All Licensees of Operating Plants and Applicants for Operating Licenses and Holders of Construction Permits, "Post TMI Requirements," dated October 31, 1980 (A02 801110 008)
2. NUREG-0737, "Clarification of TMI Action Plan Requirements," October 1980
3. Letter from E. G. Adensam (NRC) to H. G. Parris (TVA), "Human Factors Engineering Branch Control Room Review," dated March 26, 1982 (A02 820331 005)
4. Letter from L. M. Mills to E. G. Adensam (NRC) dated June 11, 1982, detailing the BLN response to reference 3 (A27 820611 005)
5. Letter from D. G. Eisenhut to All Licensees of Operating Reactors, Applicants for Operating Licenses and Holders Construction Permits, "Supplement 1 to NUREG-0737 - Requirements for Emergency Response Capability (Generic Letter 82-33)," dated December 17, 1982
6. Supplement 1 to NUREG-0737, "Requirements for Emergency Response Capability," December 1982
7. Letter from L. M. Mills (TVA) to Ms. E. Adensam (NRC) dated April 15, 1983, in response to Generic Letter 82-33 (Ref. 5) (A27 830415 013)
8. NUREG-0700, "Guidelines for Control Room Design Reviews," published September 1981
9. Special Engineering Procedure SEP 82-17, "Control Room Design Reviews for All TVA Nuclear Plants"
 - a. Revision 0 dated April 13, 1983
 - b. Revision 1 dated May 2, 1984
10. Letter from D. S. Kramer (TVA) to Ms. E. Adensam (NRC) transmitting the TVA CRDR Program Plan dated June 9, 1983 (A27 830609 001)
11. Letter from T. M. Novak (NRC) to H. G. Parris (TVA), "Comments on TVA Program Plan for Control Room Design Reviews," dated December 23, 1983 (A02 831229 001)



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WHAT

WHO

HOW

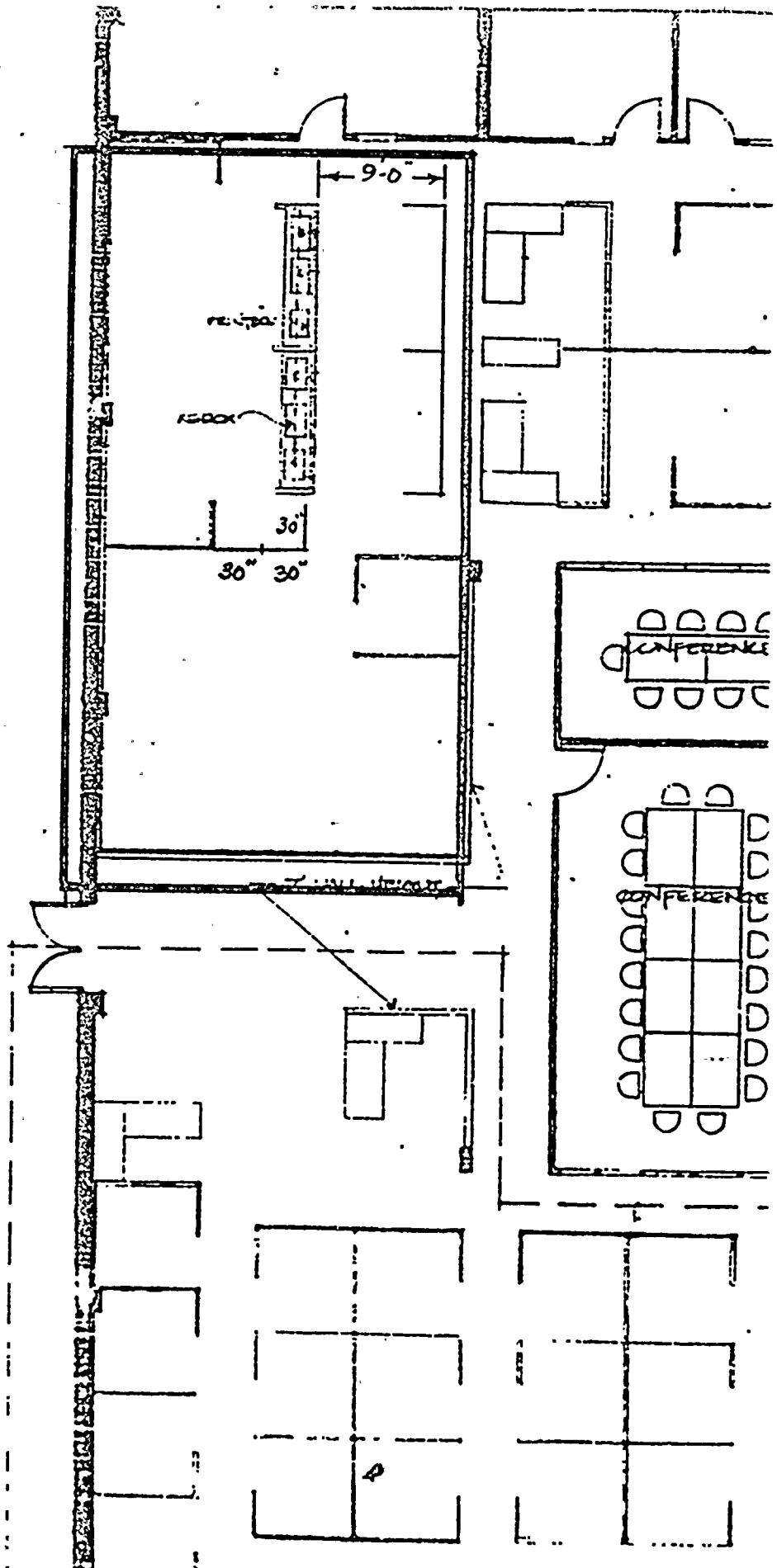
4.2.3 WEP Review

Project Engineer
(PE)

4.2.3.2b For an inadequate weld; attach concurrent Review Summary Sheet and initiated an SCR in accordance with OEP-17 Corrective Action. The SCR will complete the WDR.

4.2.3.2c For nonconcurrent Review Summary Sheet; attach sheet to original evaluation and return to Designer for resolution and preparation for resubmittal to WEP.







UNITED STATES GOVERNMENT

Memorandum

TENNESSEE VALLEY AUTHORITY

TO: H. L. Abercrombie, Site Director, Sequoyah Nuclear Plant

FROM: K. W. Whitt, Director of Nuclear Safety Review Staff, E3A8 C-K

DATE: FEB 27 1986

SUBJECT: NUCLEAR SAFETY REVIEW STAFF INVESTIGATION REPORT TRANSMITTAL

Transmitted herein is NSRS Report No. I-86-101-SQN

Subject INSTALLATION OF CONAX CONNECTORS

Concern No. N/A

and associated prioritized recommendations for your action/disposition.

It is requested that you respond to this report and the attached Priority 2 [P2] recommendation by April 28, 1986. Should you have any questions, please contact W. D. Stevens at telephone 6231-K

Recommend Reportability Determination: Yes No X

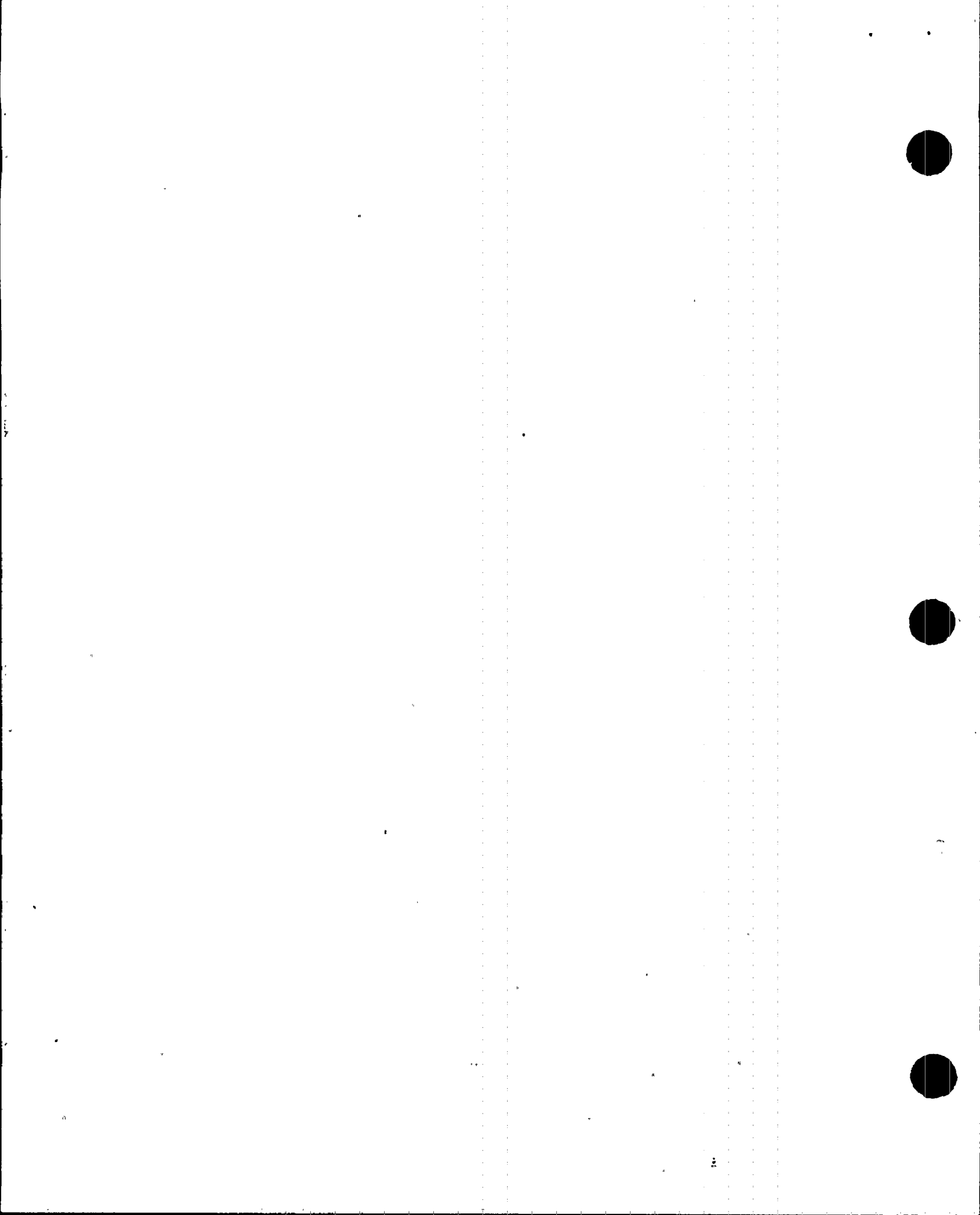
Signature of W. D. Stevens, Director, NSRS/Designee

- WDS:JTH
Attachment
cc (Attachment):
W. C. Bibb, BFN
W. T. Cottle, WBN
James P. Darling, BLN
R. P. Denise, LP6N40A-C
G. B. Kirk, SQN
D. R. Nichols, E10A14 C-K
QTC/ERT, Watts Bar Nuclear Plant
Eric Sliger, LP6N48A-C
J. H. Sullivan, SQN

Stamp: WATTS BAR NUCLEAR PLANT SITE DIRECTOR'S OFFICE MAR 03 '86. Table with columns: Note, Action, Reply. Rows: P11 Mgr, Mod Mgr, SS Mgr, OS Mgr, QA, Personnel, Finance, Compliance, Int. Ofcr, AC TO AHMS.



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UNITED STATES GOVERNMENT

Memorandum

TENNESSEE VALLEY AUTHORITY

TO: H. L. Abercrombie, Site Director, Sequoyah Nuclear Plant

FROM: K. W. Whitt, Director of Nuclear Safety Review Staff, E3A8 C-K

DATE: FEB 27 1986

SUBJECT: NUCLEAR SAFETY REVIEW STAFF INVESTIGATION REPORT TRANSMITTAL

Transmitted herein is NSRS Report No. I-85-133-SQN

Subject Electrical/Physical Separation of Redundant Circuit/Equipment

Concern No. XX-85-122-011

and associated prioritized recommendations for your action/disposition.

R.P.D.
W.D.B.

| | | | |
|--|------|--------|-------|
| WATTS BAR NUCLEAR PLANT SITE DIRECTOR'S OFFICE | | | |
| FEB 28 '86 | | | |
| | Note | Action | Reply |
| Pl Mgr | | | |
| Med Mgr | | | |
| SS Mgr | | | |
| OS Mgr | | | |
| QA | | | |
| Training | | | |
| Compliance | | | |
| IT Office | | | |
| Director's Office | | | |

This report contains one Priority 1 [P1] recommendation which must be addressed before startup. It is requested that you respond to the attached one Priority 2 [P2] recommendation by April 25, 1986. Should you have any questions, please contact W. D. Stevens at telephone 6231-K

Recommend Reportability Determination: Yes X No

W.D. Stevens
Director, NSRS/Designee

WDS:JTH

Attachment

cc (Attachment):

W. C. Bibb, BFN

W. T. Cottle, WBN

James P. Darling, BLN

R. P. Denise, LP6N40A-C

G. B. Kirk, SQN

D. R. Nichols, E10A14 C-K

QTC/ERT, Watts Bar Nuclear Plant

Eric Slinger, LP6N48A-C

J. H. Sullivan, SQN



