NUREG-0797
Supplement No. 9

Safety Evaluation Report

related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2

Docket Nos. 50-445 and 50-446

Texas Utilities Generating Company, et al.

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

March 1985

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ABSTRACT

Supplement 9 to the Safety Evaluation Report for the Texas Utilities Electric Company's application for a license to operate Comanche Peak Steam Electric Station, Units 1 and 2 (Docket Nos. 50-445, 50-446), located in Somervell County, Texas, has been prepared jointly by the Office of Nuclear Reactor Regulation and the Comanche Peak Technical Review Team of the U.S. Nuclear Regulatory Commission. This supplement addresses TUEC's analyses in support of its request to amend the Comanche Peak Final Safety Analysis Report to eliminate the commitment that coatings inside the reactor Containment Building be qualified for Units 1 and 2. In addition, this supplement provides the results of the staff's evaluation and resolution of 62 technical concerns and allegations in the coatings area for Unit 1. Because of the favorable resolution of the items discussed in this report, the staff concludes for the issues considered herein, that there is reasonable assurance that the facility can be operated by TUEC without endangering the health and safety of the public.

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ACRONYMS AND ABBREVIATIONS

AA - independent assessment program allegation
AB - American Bridge
AB - bolt allegation
ABRR - as-built reverification records
A-C - Allis-Chalmers
AC - concrete/rebar allegation
ACI - American Concrete Institute
AD - design of pipe/pipe support allegation
ADS - audit discrepancy report
AE - electrical allegation
AEOD - Office for Analysis and Evaluation of Operational Data (NRC)
AFW - auxiliary feedwater system
AH - hanger allegation
AI - intimidation allegation
AISC - American Institute of Steel Construction
ALARA- as low as reasonably achievable
AM - miscellaneous allegation
ANI - authorized nuclear inspector
ANS - American Nuclear Society
ANSI - American National Standards Institute
AO - protective coating allegation
AP - pipe and pipe support allegation
APC - AMP Product Corporation
AQ - quality assurance/quality control allegation
AQB - QA/QC bolt allegation
AQC - QA/QC concrete/rebar allegation
AQE - QA/QC electrical allegation
AQH - QA/QC hanger allegation
AQL - acceptable quality level
AQO - QA/QC coating allegation
AQP - QA/QC pipe and pipe support allegation
AQW - QA/QC welding allegation
ARMS - Automated Records Management System
ASLB - Atomic Safety and Licensing Board
ASME - American Society of Mechanical Engineers
ASTM - American Society for Testing and Materials
AT - acceptance test
AT - test program allegation
AV - vendor/generic allegation
AW - welding allegation

B&PVC - Boiler & Pressure Vessel Code
B&R - Brown & Root, Inc.
BNL - Brookhaven National Laboratory
BOC - beginning of cycle
BRHL - Brown & Root Hanger Locations
BRIR - Brown & Root Inspection Report
BRP - Brown & Root piping isometric drawing
BTP - Backfit Test Program
BWR - boiling water reactor

C&L - Corner and Lada (computer program)
C&S - civil and structural
CAR - Corrective Action Request
CASE - Citizens Association for Sound Energy
CAT - Construction Appraisal Team (NRC)
CB&I - Chicago Bridge & Iron Company
CCL - Corporate Consulting and Development Company, Limited
CCS - Component Cooling System
CCW - component cooling water
CEL - Coating Exempt Log
CFR - Code of Federal Regulations
CHN - construction hold notice
CILRT - containment integrated leak rate test
CMC - component modification cards
CMTR - certified material test report
COT - construction operation traveler
CP - Comanche Peak
CP - construction permit
CPPE - Comanche Peak Project Engineering
CPSES - Comanche Peak Steam Electric Station
CPSIG - Comanche Peak Seismic Interaction Group
CSS - containment spray system
CSTS - Construction and Startup/Turnover Surveillance Group (TUEC)
CVCS - chemical and volume control system
CZ-11 - Carboline Carbo zinc 11

DBA - design basis accident
DCA - design change authorization
DCC - Document Control Center (TUEC)
DCTG - Design Change Tracking Group
DCVG - Design Change Verification Group
DE - Division of Engineering (NRC)
DFT - dry film thickness
DL - Division of Licensing (NRC)
D-6 - Ameron Dimecote 6

E&I - Electrical and Instrumentation
ECCS - emergency core cooling system
EDO - Executive Director for Operations (NRC)
EOC - end of cycle
EOP - Emergency Operating Procedures
ERG - Emergency Response Guideline
ETG - Electrical Test Group (TUEC)

FDSG - Field Damage Study Group (TUEC)
FJO - field job orders
FP - fire protection
FSAR - Final Safety Analysis Report
FW - field weld

G&H - Gibbs & Hill
GAP - Government Accountability Project
GDC - general design criteria
GE - General Electric Corporation
GED - General Equivalency Diploma
GHH - Gibbs & Hill hanger (isometric drawing)

HFT - hot functional test
HIR - hanger inspection report
HP - hanger package
HP - high pressure
HVAC - heating, ventilation and air conditioning system
HX - heat exchangers

IAP - Independent Assessment Program
ICC - inadequate core cooling
IE - Office of Inspection and Enforcement (NRC)
IEB - Inspection and Enforcement Bulletin
IEEE - Institute of Electrical and Electronics Engineers
IM - interoffice memorandum (TUEC)
INPO - Institute for Nuclear Power Operations
IOM - interoffice memorandum
IR - inspection report (NRC)
IRN - item removal notice
ITT-G - ITT Grinnell

JTG - Joint Test Group (TUEC)
JUMA - Joint Utility Management Assessment Group

LE - left end
LOCA - loss of coolant accident
LP - liquid penetrant

M&P - mechanical and piping
MAR - maintenance action request
MCC - motor control center (GE)
MDB - master data base
MIFI - mechanical fabrication inspector
MIL - material identification list (or log)
MIME - Mechanical Equipment Inspector
MQE - Mechanical Quality Engineering
MR - material requisition
MRS - manufacturer's record sheet
MS - main steam (line)
MWDC - multiple weld data card

N/A - not applicable
NCR - nonconformance report (TUEC)
NDE - nondestructive examination
NDT - nondestructive testing
NI - never incorporated
NONSAT - nonsatisfactory
NOV - Notice of Violation (NRC)
NPSH - net positive suction head
NPSI - Nuclear Power Service Incorporated
NRC - U.S. Nuclear Regulatory Commission
NRR - Office of Nuclear Reactor Regulation (NRC)
NSSS - nuclear steam supply system

O&M - Operations and Maintenance (TUEC)
OBE - operating basis earthquake
OI - Office of Investigations (NRC)
OJT - on-the-job training
OL - operating license
ORNL - Oak Ridge National Laboratory

PC - protective coating
PCR - plant change request
PCR - protective coating report
PET - permanent equipment transfer
PFG - Paper Flow Group
PFS - pipe fabrication shop
PORV - power operated relief valve
PPM - parts per million
PSAR - Preliminary Safety Analysis Report
PSE - Pipe Support Engineering (TUEC)
PT - preoperational test
PTS - pressurized thermal shock
PWR - pipe whip restraints
PWR - pressurized water reactor
P-305 - Carboline Phenoline 305

QA - quality assurance
QAI - quality assurance investigation (TUEC)
QC - quality control
QE - quality engineer

RCB - Reactor Containment Building
RE - right end
RES - Office of Nuclear Regulatory Research (NRC)
RFIC - request for information or clarification (B&R)
RG - Regulatory Guide (NRC)
RHRS - residual heat removal system
RI - NRC Region I Office
RIR - receipt inspection report (TUEC)
RIV - NRC Region IV Office
RPE - radiation protection engineer
RPI - rod position indication
RPS - radiation protection supervisor
RPS - report process sheet (TUGCO)
RPV - reactor pressure vessel
RPVRI - reactor pressure vessel reflective insulation
RRI - Resident Reactor Inspector (NRC)
RV - reactor vessel
RWN - room work notifications

SAP - startup administration procedure
SALP - Systematic Assessment of Licensee Performance (NRC)
SAT - satisfactory
SAVC - structural assembly verification card
SER - Safety Evaluation Report (NRC)
SG - steam generator
SI - safety injection
SIS - Special Inspection Services
SMAW - shielded metal arc welding
SNM - special nuclear material
SORC - Station Operations Review Committee
SRIC - Senior Resident Inspector for Construction (NRC)
SRP - Standard Review Plan (NRC)
SRT - Special Review Team (NRC)
SSE - safe shutdown earthquake
SSER - Safety Evaluation Report Supplement
SSI - safe shutdown impoundment
SSPC - Steel Structures Painting Council
SSWP - station service water pumps
STE - system test engineer
SWA - startup work authorization
SWO - shop work order

TDCR - test deficiency change request
TDI - Transamerica Delaval, Inc.
TDR - test deficiency report
10 CFR 50 - Title 10 Code of Federal Regulations Part 50
TI - temporary instruction
TIDC - Division of Technical Information and Document Control (NRC)
TNE - TUEC Nuclear Engineering
TP - test program
TPD - test procedure deviation
Tr - transcript
TRT - Technical Review Team (NRC)
TSABC - technical services as-built coordinator
TSDR - technical services design review coordinator
TSI - thermolag
TSMD - Technical Services Mechanical Drafting
TSP - tri-sodium phosphate
TUEC - Texas Utilities Electric Company
TUGCO - Texas Utilities Generating Company
TUSI - Texas Utilities Service, Inc.

UCC - University Computing Company
USI - unresolved safety issue

UT - ultrasonic test
UTA - University of Texas at Austin

VCD - vendor-certified drawing
VT - visual weld (inspector)

W - Westinghouse Electric Corporation
WDC - weld data card
WFML - weld filler metal log
WPS - welding procedure specification

1 INTRODUCTION

On July 14, 1981, the U.S. Nuclear Regulatory Commission (NRC) issued a Safety Evaluation Report (SER) (NUREG-0797) related to the application by the Texas Utilities Electric Company (TUEC) for a license to operate Comanche Peak Steam Electric Station (CPSES), Units 1 and 2. Subsequently, eight Supplemental Safety Evaluation Reports (SSERs) were issued by the staff. This report, Supplement No. 9, addresses TUEC's analyses in support of its request to amend the Comanche Peak Final Safety Analysis Report (FSAR) to eliminate the commitment that coatings inside the reactor Containment Building be qualified. Appendix L to this Supplement provides the staff's technical evaluation of the postulated behavior of coatings in the Comanche Peak Containment Building under design basis accident conditions. This evaluation supports TUEC's analyses of its request to amend the FSAR to eliminate the commitment that coatings inside the Containment Building be qualified. Appendix M presents the Technical Review Team evaluation of 62 technical concerns and allegations in the coatings area at Comanche Peak. The actions required in Appendix M were modified based on the staff conclusions in Appendix L. The evaluations for Appendix L and M were performed concurrently by independent groups.

Appendix L

In the Comanche Peak SER (NUREG-0797), the staff found the coating system inside the Containment Buildings acceptable based on TUEC's commitment in the FSAR to meet the positions of Regulatory Guide 1.54, ANSI N101.2, and ANSI N5.12. Coatings which are controlled, applied, and tested to be consistent with these positions are considered "Qualified" for a design basis accident (DBA) environment. TUEC proposed to amend the FSAR to eliminate the commitment that coatings inside the Containment Building be qualified on June 4, 1984. In Appendix L, TUEC's proposal was found acceptable, based on a detailed review by the NRC Office of Nuclear Reactor Regulation, which demonstrates that a total failure of protective coatings inside the Containment Building would not adversely affect the performance of post-accident fluid systems. Accordingly, any deficiencies which might result in coating failures would not result in or contribute to causing, or increasing the consequences of, any design basis accident; for this reason, it is not necessary that coatings be qualified.

Appendix M

The technical concerns and allegations regarding the coatings program at Comanche Peak were part of the outstanding regulatory issues that remained as construction of the Comanche Peak facility neared completion. The NRC's Executive Director for Operations (EDO) issued a directive on March 12, 1984, establishing a program for assuring the overall coordination, integration, and resolution of these issues prior to the staff's licensing decision. In response to the EDO's directive, a program plan was developed and approved on June 5, 1984, by the Directors of NRC's Office of Inspection and Enforcement, Office of Nuclear Reactor Regulation, and the Administrator of NRC's Region IV Office. This program plan, entitled Comanche Peak Plan for the Completion of Outstanding Regulatory Actions, specified the critical path issues, addressed the scope of work needed, and provided a projected schedule for completion.

Attachment 1 to Appendix M is a listing of the technical concerns and allegations in the protective coatings area. The TRT evaluation of the protective coatings area revealed many specific deficiencies which render a large percentage of the coatings at CPSES unqualified. However, consistent with the findings of Appendix L, TUEC has provided justification that debris generated from the failure of all paint in the Containment Buildings under design basis accident conditions will not adversely affect the performance of post-accident fluid systems. Because coatings inside the Containment Buildings need not be qualified, the TRT does not recommend that deficiencies be remedied in the applied coatings at CPSES.

Based on TUEC's prior FSAR commitment to provide qualified coatings inside the Containment Buildings, coatings applied before issuance of Appendix L to this SSER were required to have been qualified. The failure of TUEC to fulfill that commitment indicates deficiencies in the quality assurance/quality control (QA/QC) program. Although not of safety significance in the coatings area, these deficiencies will be considered in the TRT's evaluation of the effectiveness of TUEC's overall QA/QC program.

Management and coordination of all the outstanding regulatory actions for Comanche Peak are under the overall direction of Mr. Vincent S. Noonan, NRC Comanche Peak Project Director. Mr. Noonan may be contacted by calling 301-492-7903 or by writing to the following address:

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Copies of this Supplement are available for public inspection at the NRC's Public Document Room at 1717 H Street, NW, Washington, D. C. 20555, and the Local Public Document Room, located at the Somervell County Public Library On The Square, P. O. Box 1417, Glen Rose, Texas, 76043. Availability of all material cited is described on the inside front cover of this report.

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APPENDIX L

THE EFFECTS OF PAINT AND INSULATION DEBRIS ON THE PERFORMANCE OF POST-ACCIDENT FLUID SYSTEMS AT COMANCHE PEAK STEAM ELECTRIC STATION UNITS 1 AND 2

Table of Contents

1.0 INTRODUCTION

In the NRC Safety Evaluation Report (SER) on operation of Comanche Peak Steam Electric Station (CPSES) (NUREG-0797), the staff found the coating systems to be used inside the Containment Building acceptable based on the Texas Utilities Electric Company (TUEC) commitment in Section 6.1.2 of its Final Safety Analysis Report (FSAR) to apply "qualified" coatings consistent with the positions of Regulatory Guide 1.54 and ANSI N101.2. By letter dated June 4, 1984, TUEC proposed to amend the FSAR to eliminate the commitment to apply qualified coatings. TUEC provided additional information in support of the proposed amendment by letters dated June 29, 1984, July 26, 1984, August 17, 1984, Spetember 10, 1984, October 12, 1984, November 2, 1984, December 17, 1984, January 11, 1985, and February 7, 1985.

The NRC Standard Review Plan (SRP), Revision 0 of Section 6.1.2 (November 1975), identified the need to address the quality of paints used inside the reactor Containment Buildings. Revision 1 of SRP Section 6.1.2 (December 1978) addresses the requirements to meet that need by stating that coatings used inside the Containment Building are acceptable if they are applied and tested in accordance with the positions of NRC Regulatory Guide 1.54 and ANSI N101.2, or if the applicant provides justification to show that debris generated under design basis accident conditions will not adversely affect the performance of post-accident fluid systems. Revision 2 of SRP Section 6.1.2 (July 1981) retains the position that coatings be applied in accordance with Regulatory Guide 1.54 and ANSI N101.2, unless the applicant provides an acceptable alternative.

The transmittal memo for SRP Section 6.1.2, Revision 0, states that "for some time" after an SRP section is published, NRC will review applications in accordance with prior criteria. NRC staff reviewers were further directed to adapt the SRP section to the particular needs of applications based on positions prior to the latest revision(s) and to make appropriate allowances for the difference in positions when determining their acceptability.

Based on the preceding guidance, NRC evaluates each application for compliance with the criteria of SRP Section 6.1.2 consistent with the date the application is docketed and the status of Containment Building painting at the date SRP Section 6.1.2 was issued. Accordingly, the NRC staff has reviewed TUEC's proposed amendment in accordance with Section 6.1.2, Rev. 2, of the Standard Review Plan (NUREG-0800).

2.0 POTENTIAL EFFECTS OF PAINT DEBRIS ON THE PERFORMANCE OF ENGINEERED SAFEGUARDS

The design basis accident (DBA) of concern for coatings in the Containment Building is a loss-of-coolant accident (LOCA) because of the pressure, temperature, and radiation conditions which can exist and which may affect coating adhesion and result in the generation of debris from flaking and peeling. Potential safety concerns stemming from paint debris which could be created from a LOCA in the Containment Building include the following:

(a) blockage of Containment Building emergency sump debris screens;

(b) blockage of Containment Building spray system nozzles, of residual heat removal/safety injection (RHR/SI) system flow passages and of equipment;

(c) generation of hydrogen in the Containment Building;

(d) blockage of filters in Containment Building air handling systems;

(e) degradation of emergency core cooling system (ECCS) performance by the entrainment of fine particles of paint debris; and

(f) fouling of reactor core heat transfer surfaces and blockage of core flow.

Each of these potential safety concerns is discussed in detail in Sections 2.1 through 2.6.

2.1 Blockage of Containment Building Emergency Sump Debris Screens

TUEC has performed a detailed analysis of the potential for, and the effects of, debris blockage of the Containment Building emergency sumps. Generation and transport of both paint and insulation debris were considered in this analysis and are discussed in Sections 2.1.1 through 2.1.5. TUEC's analysis follows the guidance and methodology developed by the NRC staff in conjunction with the work for unresolved safety issues (USI) A-43, Containment Emergency Sump Performance (References 12 and 20).

2.1.1 Paint Debris Effects

In its analysis, TUEC postulated that, as a worst case, all coatings inside the Containment Building (the inside surfaces of which are estimated to be 618,000 square feet) could fail and form debris. The transport of such debris following a LOCA was analyzed to estimate the potential sump screen debris blockage and attendant net positive suction head (NPSH) pressure drop (or head loss) for the residual heat removal (RHR) and Containment Building spray pumps.

Since the transport of debris is a function of recirculation water velocity (flowing water with entrained particles) and particle size, TUEC analyzed the containment flow fields and the entrainment characteristics as a function of particle size. These analyses showed that paint debris would not be transported from far regions (relative to sump location) within the Containment Building due to the very low recirculation velocities predicted. This part of the analysis, termed "far-field" effect, supported reducing the region of concern to the 60°-0-315° azimuthal area. This effect allowed for reducing the amount of failed paint which could potentially affect screen blockage to approximately 95,400 square feet.

For the coated surfaces in the immediate vicinity of the sump screens, where flaking paint particles could fall directly into the pool near the screens, TUEC performed a "near-field" analysis of paint particles to assess potential screen blockage. The model calculated the trajectory of the particles in the pool as a function of local water velocity and settling velocity to determine screen blockage. These two-dimensional flow field calculations showed that due to the presence of the sump cover plate overhang, an area of at least 24 square feet would remain open at the top of the sump screen structure (each sump has a total fine screen area of 356 square feet), resulting in a maximum estimated blockage of approximately 95 percent, regardless of particle size. Particles less than 0.125 inches (1/8 inch) in diameter which did not settle out on lower screen regions would pass through the debris screen.

TUEC estimated a blocked screen head loss of about 0.4 feet of water, using data obtained from full-scale, hydraulic model testing of the Comanche Peak sump design at Western Canada Laboratory; independent NRC staff assessments of the same experimental data estimated the head loss to be 0.5 ± 0.3 feet of water. Since the available NPSH margin for the RHR pumps and containment spray pumps is 4.23 feet and 5.81 feet of water, respectively, adequate NPSH margin will remain despite paint debris blockage.

The staff reviewed the analytical approach used by TUEC in applying the calculational methods and findings from NUREG/CR-2791 (Reference 20) and NUREG-0897, Revision 1,* to analyze potential sump debris blockage caused by paint debris transport and the associated impact on NPSH margin. Based on this review and on independent assessments, the staff finds that TUEC's analysis is sufficiently conservative and that the postulated failure of all Containment Building coatings would not substantially reduce the NPSH margin to the RHR and CSS pumps. The related details of TUEC's analysis and staff findings are presented in the sections which follow.

2.1.1.1 Characteristics of Paint Debris

Approximately 285,000 square feet of concrete and 333,000 square feet of steel surfaces in the Comanche Peak Containment Building are covered by coatings which have a specific gravity ranging from 1.5 to 4.0. As a worst case, TUEC assumed that all coatings failed completely. The failure modes for coatings are chalking (powdering) and peeling (flaking). TUEC assumed the latter failure mode occurred, which is the more conservative assumption from the standpoint of its potential for sump screen blockage.

The coatings applied at CPSES consisted primarily of inorganic zinc primers and organic top coats of the same generic type as have been qualified by other nuclear plants for the design basis accident (DBA) environment. Exposure of these coatings, if properly applied, to DBA conditions of temperature, pressure and radiation does not result in flaking or peeling. If improperly applied, enough flaking and/or peeling may occur at DBA conditions to generate debris. TUEC's assumption that all coatings inside of the Containment Building will fail and generate debris is conservative.

With inorganic zinc coatings, a slight amount of "chalking" occurs, creating powder particles in the micron size range. Organic coatings remain intact, showing at most a few small blisters. The fine powder particles from the chalking of inorganic zinc coatings are inert and would have no tendency to adhere to each other or to solid surfaces. Inorganic coatings suffer relatively little radiation damage compared to organic coatings.

For the generic types of organic coatings used in the CPSES Containment Building, the degree of cross-linking and disolvation (loss of plasticizer and monomer) would be increased by heat and radiation exposure, thus making the polymers harder and more brittle (References 1 and 2). Flakes of this nature would not agglomerate or stick to other solid surfaces. Some coatings may flake off Containment Building surfaces because they were not properly applied.

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*NUREG-0897, Rev. 1 (Unpublished), "Containment Emergency Sump Performance--Technical Findings Related to Unresolved Safety Issue A-43," March 30, 1984.

Since the fine screens of the Containment Building sumps have 1/8-inch openings, larger debris has the potential to block the sumps. TUEC conservatively assumed 1/8-inch particles in the sump blockage analysis, since these would lead to screen blockage, and because larger debris particles are more difficult to transport to the vicinity of the sump screens due to the generally low flow velocities predicted to occur in the Containment Building following a LOCA.

The effects of paint debris smaller than 1/8 inch are addressed in Sections 2.2, 2.4, 2.5 and 2.6 below.

2.1.2 Flow Field Water Velocities

The flow pattern within a Containment Building is plant-specific and is a function of the building's interior design. For the Comanche Peak Containment Building, spray headers are located in the dome and at each floor elevation.

To calculate one-dimensional global water velocities in the Comanche Peak Containment Building during the recirculation phase, TUEC applied methodology developed as part of the staff resolution of USI A-43, as reported in NUREG/CR-2791 (Reference 20). More detailed two-dimensional flow field calculations were performed to evaluate local debris blockage effects. The water velocity at a given point in the building determines the transport potential for debris. The calculated water velocities were compared with the threshold velocity needed to transport debris of a selected size and were found to be too low to transport paint debris from far regions of the Containment Building.

The NRC staff reviewed TUEC's approach to applying the USI A-43 debris transport methodology and evaluated the uncertainties and conservatisms in calculating water velocities. The acceptability of TUEC's characterization of certain plant-specific features which could have an important effect on the outcome of the analysis were verified by the staff during a site visit. Based on its review, the staff finds that the water velocities have been calculated in a reasonable manner for the debris transport evaluation.

2.1.3 Paint Debris Transport

The paint debris transport model was based on the methods described in NUREG/CR-2791 (Reference 20) for the transport of insulation debris. TUEC studied the transport of paint particles of different sizes and densities, and determined that a threshold water velocity of 0.27 ft/sec would be required to transport 1/8-inch paint particles. Since water velocities on the upper floors range from 0.3 to 1.2 ft/sec, all paint debris generated on the upper floors could be transported to the sump level. (Four-inch curbing would direct debris toward stairways and grates.) At the sump level, the calculated water velocities are generally below 0.2 ft/sec; however, at doorways and other reduced area passageways, velocities on the order of 0.4 to 0.7 ft/sec were calculated. Although general water velocities in the pool on the containment floor were calculated to be less than 0.27 ft/sec, TUEC assumed that all debris near the sump zone could be transported to the sump because of the increased velocities at reduced area passageways. That is, only 95,400 square feet out of 618,000 square feet of coating debris is available to be transported to the containment floor at the sump level. TUEC conservatively assumed that the paint particles would be transported, accumulating at the base of the screens with a 45-degree angle of

repose for blockage estimates. The threshold water velocity of 0.27 ft/sec for 1/8-inch paint particles calculated from TUEC's far-field debris transport model is conservative compared with the velocity considered necessary to suspend and transport coal slurries of similar particle size and density. Water velocities in excess of 2 ft/sec are required to transport 1/8-inch coal particles (specific gravity = 1.4) in either a suspended condition or as a sliding bed in large diameter horizontal pipes (References 3, 4, and 5). At lower velocities, the particles tend to settle out. The viscosity of water at a temperature of 200°F is 1/3 its value at room temperature. Therefore, the resistance to particle settling is decreased, and the threshold velocity needed for transporting particles would be correspondingly increased.

The threshold velocity may also be estimated from the observation that "a linear velocity equal to about seven times the terminal [settling] velocity of the largest particle in the slurry is necessary to maintain adequate suspension" (Reference 4). The terminal settling velocity for coal particles passing a 1/16-inch sieve is given as 0.224 ft/sec (Reference 5). Coal particles of this size would weigh approximately the same as 1/8-inch diameter, 0.005-inch-thick paint discs. The water velocity for adequate suspension in horizontal flow at ambient temperature is, therefore, about 1.57 ft/sec. At higher temperatures, higher water velocities would be needed for particle transport because of decreased viscosity and density. Particles would move by saltation or as a sliding bed at a somewhat lower velocity. By either estimation, TUEC's value of 0.27 ft/sec for threshold water velocity is judged to be conservative.

2.1.4 Near Sump Effects

Results of TUEC's study of near sump effects indicate that a large area of the fine screens can be blocked by paint debris, assuming that paint fragments larger than the minimum screen opening reach the sump, stick to the surface, and do not overlay other fragments. A solid steel plate at the top of the sump extends more than 1 foot outward from the fine screens, and approximately 8 inches outward from the coarse screen. The near-sump fragment trajectory analysis and detailed two-dimensional flow field calculation show that a 2-inch band at the top of the fine screen will remain free of paint debris due to this design feature. In addition, a portion of the screen facing away from the primary sources of paint debris will remain partially open.

TUEC's transport model for the region near the sump is also conservative in considering the terminal settling velocity of paint chips to be 0.16 ft/sec for the tumbling chips. The data for equivalent 1/16-inch coal particles indicated a settling velocity of 0.224 ft/sec at ambient temperature and approximately three times this value at 200°F (Reference 6). Based on the staff's independent evaluation of TUEC's debris transport model, there is reasonable assurance that significant sump screen blockage by paint debris will not occur.

2.1.5 Insulation Debris

The generation and transport of insulation debris were analyzed in accordance with the guidance presented in NUREG-0897 ("Containment Emergency Sump Performance"), Rev. 1. There are three types of insulation used inside the Comanche Peak Containment Building. The first is the reflective metallic type, which comprises the largest portion of insulation. The second type is high-efficiency

metallic thermal insulation, composed of fibrous media and fine, heat-resistant particulate matter totally encased in stainless steel. The third type is an antisweat insulation used on cold water piping, which is fiberglass, encapsulated in metal casing.

Since jet impingement from pipe breaks is the most significant debris generation mechanism for insulation, the analysis considered 20 high energy pipe break locations to maximize estimated debris generation. For reflective metallic insulation, the hot-leg break in steam generator (SG) compartment 4, which is the closest to the sumps, was selected and evaluated for debris generation. For reflective metallic and high-efficiency metallic insulation, flow velocities along the flow pathways are insufficient to transport them to the sump. For the third type, encapsulated insulation, none of the postulated pipe breaks in the vicinity of this type of insulation were sufficiently energetic to cause actuation of the safety injection or containment spray systems. The recirculation flow velocity analysis provided showed that transport velocities between the "break" compartment and the sump were less than 0.2 ft/hr; therefore, transport of insulation debris initially deposited in the SG compartment is highly unlikely. Therefore, the staff has concluded that insulation debris will not contribute to sump blockage.

2.2 Blockage of Containment Building Spray System Nozzles and RHR/SI System Flow Passages and Equipment

The recirculation inlets to the RHR/SI and containment spray systems are protected by sump structures composed of trash racks, coarse screens, and fine screens. The fine screens are sized to preclude particles larger than 1/8 inch in diameter from passing through. The containment spray nozzles, spray pumps, and RHR/SI system flow passages can accommodate 1/8-inch particles without clogging. Therefore, the staff finds that the fine screens of the sump structures will protect against the injection of debris which could have a detrimental effect on the emergency core cooling and containment spray systems.

2.3 Containment Building Hydrogen Generation

The primer coat on steel surfaces is a zinc-based paint which, on exposure to hot water, can oxidize to form zinc oxide and release hydrogen gas from the water. The design basis hydrogen generation analysis for the plant was previously calculated based on the assumption that all zinc in the coatings reacts to form hydrogen. Therefore, because the maximum generation has already been taken into account, there is no need to consider hydrogen generation any further.

2.4 Blockage of Filters in the Containment Building Air Handling Systems

Under LOCA conditions, it is not likely that paint debris would become airborne, because of the scrubbing effect of the containment spray and the high density of the debris. The only system having filters which could potentially be affected by airborne paint chips is the post-accident containment atmosphere cleanup system. However, since the system is a small, low-capacity system, and would only be operated in the long term following onset of an accident, at which time any potential airborne paint debris would have settled, it would not pose a problem relative to system performance.

2.5 Degradation of ECCS Performance by the Entrainment of Fine Particles of Paint Debris

Sections 3.2, 3.2.2, and the Appendix of a Gibbs & Hill Report (Reference 7) discuss the potentially adverse effects to emergency core cooling system (ECCS) performance following a complete failure of the Containment Building paint during a design base LOCA in which paint particles of 1/8 inch or smaller pass through the containment sump screens. The staff requested additional information regarding: (1) the long-term corrosion and erosion effects on ECCS performance and heat transfer capability, and (2) calculation of the extent and consequences of core flow blockage by paint flakes of 1/8 inch or smaller. Subsequently, the staff requested additional clarification of TUEC's responses on the large break LOCA and information on the effects of containment paint failures for a spectrum of small break LOCAs. TUEC's responses to these requests and to Reference 7 are evaluated below.

2.5.1 Large Break LOCA

With respect to blockage of the ECCS flowpaths due to entrained paint particles, TUEC provided additional information in References 7 through 10. TUEC performed a bounding analysis in which it was assumed that approximately 278 cubic feet of paint (i.e., the paint volume in the 60°-0-315° sector of the Containment Building above and adjacent to the ECCS sumps) would be entrained in the ECCS fluid; the resulting total debris concentration suspended in the circulating fluid would be less than 1 percent by volume. TUEC indicated that two types of regions within the ECCS recirculation flow paths may make it possible for paint particles to settle out of the fluid streams, i.e., regions in which the fluid flows vertically at low velocity (such as the reactor vessel lower plenum), and long horizontal pipes in which the fluid velocities are low enough that the paint particles settle out at the bottom. TUEC also indicated that for small pipes and heat exchanger tubes with higher flow velocity, the paint particles would be carried along with the fluid.

To evaluate TUEC's findings that the ECCS would not be blocked, the staff reviewed the flow paths in the low head recirculation mode and concluded that there are no small valves or small bore orifices that would be blocked due to the entrained paint particles. With respect to blockage and fouling due to agglomeration on the surfaces in the ECCS low head recirculation flow path, the RHR heat exchanger tubes would be most limiting. Blockage and fouling of the tubes would not occur under the combined temperature and radiation conditions that would prevail during the LOCA recirculation phase due to the physical properties of the paint, as discussed in Section 2.1.1.1, above.

The staff has generically evaluated the effects of debris entrainment of up to 2.5 volume percent on RHR pump performance (Reference 12). In Reference 12 the staff recommends an assessment of RHR pump peformance based on plant-specific estimated debris concentrations and properties. TUEC estimated that the maximum concentration of entrained debris would be less than 1 percent (References 7 through 10). The staff independently verified TUEC's estimated debris concentration. In Reference 10, the RHR pump vendor states that the concentration and properties of debris estimated by TUEC are expected to have a negligible effect on pump performance. Based on the preceding evaluation, reasonable assurance exists that the RHR pumps will not be adversely affected by failure of all coatings in the Containment Building.

TUEC has also indicated in Reference 10 that the potential for clogging the pump seal cavity and recirculation tubing is very low since the seal cavity is isolated from the main pump flow by close clearance between the pump shaft ring bushing and the pump shaft. The staff concurs with this conclusion based on information contained in Reference 12, which evaluates RHR pump performance in scenarios similar to this situation. The staff concludes that TUEC has provided reasonable assurance that the low head recirculation portion of the ECCS would retain its heat removal capability under these conditions.

2.5.2 Small Break LOCA

In the event of a small break LOCA larger than 1 inch, or a stuck open power operated relief valve (PORV), high head recirculation could be utilized, requiring operation of the safety injection and/or centrifugal charging pumps, and utilizing the high head injection lines, which are relatively small and contain orifices and throttling valves. With regard to the latter, TUEC indicated that the high fluid velocities (25 to 40 ft/sec) in these lines, valves, and orifices preclude any line clogging from paint particles. Based on a staff request, TUEC obtained the orifice diameters and flow areas of the valves in their throttled condition and found that the clearances are sufficient. Also, there is sufficient flow path redundancy to assure that SI flow to the RCS would be retained even if the smallest clearance throttle valve became clogged.

The staff expressed its concerns about the effect of suspended paint particles on sustained operation of the multi-stage high head SI pumps, which would be more sensitive to entrained solids than the single stage RHR pumps, and about the effect of RCP restart on core flow. The staff request for additional information on these subjects was as follows:

(1) The staff cannot conclude from the information provided for small break LOCAs that the high head pumps can perform acceptably in the presence of paint particles in the sump coolant. In order to complete our review, the applicant must demonstrate that either:

(a) For all design basis accidents, recirculation from the sump using the high head pumps is not required to meet any of the Commission's regulations. In particular, for the small break LOCA, the applicant must demonstrate that the long term cooling requirement of 10 CFR 50.46 is met without reliance on the high head pumps in the recirculation mode. If demonstration relies on operator action, we require evidence that the operator can reliably perform the necessary actions. This evidence must include a demonstration that the operators have had sufficient training in the necessary action, have demonstrated their ability to perform the necessary action, (e.g., on a simulator), and that the emergency operating procedures (EOPs) have been revised to clearly provide the necessary guidance.

or,

(b) Provide evidence, preferably experimental or test data, to show that the high head pumps can perform acceptably over the period of time necessary to maintain long term core cooling assuming paint particles

in the sump water. As a minimum, we require a statement from the pump manufacturer regarding their pumps' performance capability in this mode.

(2) Discuss whether the reactor coolant pumps could be restarted during the recirculation phase and the potential for core blockage assuming the maximum debris volume stored in the reactor vessel lower plenum.

TUEC responded (Reference 11) that after a small-break LOCA, the total volume of debris passing through the sump screen would be less than 10 cubic feet. Such a volume would result in a total debris concentration in the circulating coolant of less than 200 ppm, of which less than half would be abrasive. The methodology for calculating particle transport utilized in this reference was evaluated in Sections 2.1.3 and 2.1.4 of this Appendix and found to be conservative. TUEC further assumed that the percentage of fines below 1/8 inch in diameter in the paint debris was not over 1 percent for concrete paint and not over 5 percent for steel coatings. The staff independently confirmed that these estimates of the size distribution of failed coating particles were consistent with DBA test experience and paint industry experience. TUEC's calculations of fine debris volume considered only the 95,400 square feet of paint in the 315°-0-60° azimuthal region of the Containment Building. TUEC's previous conclusion that paint debris from the remaining azimuthal regions would not reach the sump was based on the assumption that particles would be 1/8-inch in diameter. If the fine particles from all 618,000 square feet of coatings could reach the sump, TUEC's detailed method of calculation (Reference 11) would yield a total fine debris of approximately 20 cubic feet. However, TUEC's analyses in supplementary Table 2 of Reference 11 demonstrate that only fines of less than approximately 4.0 mils could be transported from far field regions because flow velocities at the sump elevation, from these regions to the sump screens in the 60°-0-315° azimuthal Containment Building region are, in most cases, less than 0.1 feet per second. Based on the staff's independent analyses and on the information in References 3, 4 and 5 on particle transport, most of the particles outside the 60°-0-315° azimuth would settle before reaching the sump screens. Those that reached the sump would amount to only a fraction of the total fines.

Therefore, the staff finds that TUEC's estimates of fine debris volume, and of the concentrations of abrasive and non-abrasive debris concentrations in the circulating coolant, are acceptably conservative.

TUEC described operability tests that have been performed by the manufacturer on multi-stage high head and low head safety injection pumps with a debris concentration of 92 ppm, including 60 ppm of abrasive materials (concrete and glass). The pumps were operated in the hot condition for a period of 10 hours (Reference 11) and the change in hydraulic performance was less than 1 percent. Vibration levels did not change throughout the tests, and when the pumps were disassembled there was no sign of wear, nor did the mechanical seal exhibit leakage before, during, or after the test. The CPSES pumps are of similar design to those tested, and utilize the same wear-resistant materials for the impellers, wear rings, and seals. The CPSES pump vendor, Pacific Pumps, has provided a letter (attached to Reference 11) that states that the CPSES charging and SI pumps would "function properly without any significant impairment in performance" with a total of 200 ppm of debris, including 100 ppm abrasives.

Based on the information above, including the pump vendor's statement regarding operability, the staff concludes that TUEC has provided reasonable assurance that the safety injection portion of the ECCS would retain its operability with the postulated debris concentration.

The staff was concerned that restart of the RCPs could introduce paint particles of up to 0.125 inches into the reactor core if the ECCS were operated in the recirculation mode, since the lower plenum fluid velocity at restart would be sufficient to carry particles previously trapped in the lower plenum into the core. With respect to the question regarding RCP restart following recirculation, the staff determined that the RCPs could be restarted under the following conditions:

(1) During the post-LOCA cooldown and depressurization;

(2) In the event of inadequate core cooling (ICC), if the core exit thermocouples indicate a temperature equal to or greater than 1200°F;

(3) In the event of an imminent pressurized thermal shock (PTS) condition.

In Reference 13, TUEC indicated that RCP restart during ICC would have an event frequency of less than 10^{-8} per reactor year. The staff considers this number optimistic, but concurs with TUEC that restart under these conditions has a low probability. The staff concludes that RCP restart in the recirculation mode because of PTS is also a low probability event. During the post-LOCA cooldown and depressurization mode, the Emergency Response Guidelines (ERGs) instruct the operator to restart the RCPs if both generic and plant-specific restart criteria are met. TUEC indicates that RCP restart during the post-LOCA cooldown for breaks large enough to require recirculation is not likely because of Comanche Peak plant-specific requirements (e.g., restart of component cooling flow and leak-off flow if terminated as a result of containment isolation). Additionally, in Reference 19 TUEC stated that the attachments to the Emergency Response Guidelines (ERGs) would be changed to state that a RCP should not be started if containment spray has been actuated and transfer to cold leg recirculation has been performed, with the exception of ERG FRC-0.1 (Response to Inadequate Core Cooling). As discussed above, inadequate core cooling is a low probability event. The staff concludes that RCP restart following ECCS recirculation is unlikely at Comanche Peak.

The staff finds that its and TUEC's independent analyses provide reasonable assurance that in the event of a large or small break LOCA, coincident with LOCA-induced Containment Building paint failure, the long term decay heat removal capability of the ECCS would not be unacceptably degraded.

2.6 Fouling of Reactor Core Heat Transfer Surfaces and Core Flow Blockage

The staff reviewed TUEC's information in References 8, 9, and 10 to assess core flow blockage caused by paint particles detaching from the Containment Building surfaces during a large break LOCA. Based on this review, the staff concluded that because the particles carried into the reactor core are smaller than the minimum flow area in a fuel bundle and can therefore pass through the core, core flow blockage caused by these paint particles is not a concern during cold leg recirculation following a large break LOCA. Subsequently, in

response to NRC questions, TUEC indicated in Reference 11 that under certain conditions the operator is required to restart the RCPs following a small break LOCA. Restart of the RCPs would result in larger particles being carried into the core from the reactor vessel lower plenum. The staff was concerned that larger particles could accumulate in the core and cause flow blockage. The results of the evaluation of this concern are given below.

2.6.1 Large Break LOCA

For a postulated large break LOCA, it is assumed that paint particles are stripped from Containment Building surfaces and transported into the reactor vessel during ECCS recirculation. Whether the paint particles would settle to the bottom of the reactor vessel lower plenum or would be transported into the core can be calculated by performing a force balance on a particle of a given size which accounts for gravity, drag, and hydrostatic forces. The important parameters to determine the particle settlement are fluid velocity and particle size. TUEC indicated in Reference 8, and the staff independently verified, that the maximum fluid velocity at the entrance to the core during ECCS recirculation following a large break LOCA is 0.3 ft/sec, assuming a hot leg break with two RHR pumps operating. Given this fluid velocity, TUEC calculated the largest particle size that could enter the core during ECCS recirculation to be less than 0.036 inches in diameter, which is smaller than the minimum dimension of 0.040 inches in the spacer grids. As a result of this calculation, TUEC concluded that the particles carried into the core will pass through the core, and thus will not block flow in the fuel assemblies.

Particles up to 0.125 inch in diameter can pass through the sump screens and are potentially available, but the calculation described above shows that the low flow velocity will not carry these particles into the core. Larger particles transported into the vessel will settle out in the reactor vessel lower plenum. These particles are brittle and do not stick at the temperature existing during ECCS recirculation. The largest particles carried into the core are smaller than the minimum flow area in the core. In view of these considerations, the staff agrees with TUEC that the particles transported into the core will pass through it and not block flow during ECCS recirculation following a large break LOCA.

2.6.2 Small Break LOCA

As concluded in Section 2.5.2 of this Appendix, RCP restart following ECCS recirculation is unlikely at CPSES. This section evaluates the potential for core blockage in the unlikely event that an RCP is restarted.

For ECCS recirculation with restart of reactor coolant pumps (RCPs) following a small break LOCA, it is assumed that the high fluid velocity will result in particles up to the 0.125-inch maximum being carried into the core.

Reference 11 estimates that less than 10 cubic feet of paint particles can be carried into the vessel during this scenario. A simple, bounding calculation, assuming that all materials are carried into the core and are stopped by the first grid, shows that a layer up to 1-inch thick would form. Such a layer could result in flow blockage, but is not expected to have this effect for several reasons. First, as stated previously, the paint particles would remain brittle and would not adhere to the grids or fuel rods. Second, any significant

accumulation would cause flow pressure gradients which would tend to disperse the smaller particles before the buildup could become widespread, and therefore significant in terms of core cooling. The pressure difference could also break up the brittle, thin paint particles into smaller particles. It is difficult, however, to determine how the effects of pressure gradient would be balanced with the accumulation of particles in the small spaces between the grids and fuel rods.

Even if paint particles were to accumulate, the information provided in Reference 16 demonstrates that a porous blockage (such as that most likely to be formed in the case of paint particle accumulation) would still provide "a small residual flow," which would result in a flow pattern which is "on the whole... nearly unchanged" from the unblocked flow pattern. Based on this result, fuel failure would not be expected. Even if flow blockage were to occur, the fuel bundle design at CPSES is such that the ratio of heat transfer area to flow area is large so that a large fraction of the flow area must be blocked before there is a significant heatup of the fuel rods. In Reference 18, it is concluded that for a boiling water reactor (BWR) fuel assembly, a flow reduction of greater that 79 percent is necessary to cause loss of nucleate boiling and that a flow blockage of greater than 95 percent is necessary for fuel cladding to melt. While these numbers include a small amount of bypass flow which is available in a BWR assembly when the inlet is blocked, the numbers provide a qualitative indication that the amount of blockage required to produce these adverse effects is large. A BWR fuel assembly is surrounded by a channel box which does not permit flow to merge with the rest of the core. The pressurized water reactor (PWR) fuel assemblies to be used at Comanche Peak, with their open lattice configuration, would be expected to decrease the consequences of a blockage of only one assembly due to cross-flow from adjacent assemblies. The analyses of Reference 18 were done assuming full core flow. At Comanche Peak, only one RCP would be in operation following a small break LOCA. The lower core flow could tend to make these results less conservative, but the qualitative results would still be valid.

The Comanche Peak FSAR reports that tests on simulated PWR fuel bundles of the type used at CPSES (Reference 15) indicate that blockages of 41 percent of the subchannels in the center of a bundle between spacer grids will not cause significant loss of flow because the stagnation zone disappears a short distance past the blockages. The FSAR concludes that "local flow blockages within a fuel assembly have little effect on subchannel enthalpy rise." The staff concurs with this conclusion and has cited these data in the past in connection with concerns over local blockages caused by loose parts.

The results of an extrapolation of the BWR calculations and PWR bundle data to a core-wide blockage is not clear and has not been addressed by TUEC.

The staff's qualitative conclusion based on the facts presented above is that the flow blockage must be extensive in order to cause fuel rod damage. Restart of a RCP following ECCS recirculation is unlikely. For the reasons discussed above, a complete blockage at the lower fuel assembly grid is unlikely if an RCP is restarted. A flow blockage sufficient to cause fuel failure is also unlikely. If localized flow blockage were to occur, the staff would expect the extent of fuel failure, if any, to be low.

The staff finds that TUEC's analyses provide reasonable assurance that in the event of a large or small break LOCA that is coincident with LOCA-induced containment paint failure, the long-term decay heat removal capability of the ECCS would not be unacceptability degraded. The staff also concludes that RCP restart following a small break LOCA is unlikely. If an RCP were to be restarte. following recirculation, a complete blockage at the lower fuel assembly grids due to paint particles is unlikely. A flow blockage sufficient to cause fuel failure is also unlikely. If localized flow blockage were to occur, the extent of fuel failure, if any, would be expected to be low. Long-term core coolability would not be impaired.

2.6.3 Reactivity Effects of Paint Particles

Following either a small or large break LOCA, there is a possibility that paint debris could enter the water circulating through the ECCS via the containment sump. TUEC has estimated the amount of paint debris that could be present in the circulating water for both the large break LOCA (in amounts of less than 1 percent by volume) and the small break LOCA (in amounts of about 200 parts per million). (The paint debris consists mainly of zinc primer and various organic compounds.) The staff evaluates, below, the reactivity effect of TUEC's estimates of paint debris for the reactor at end of cycle (EOC) when, following a small or a large break LOCA, the circulating water would contain about 1800 ppm of boron.* (The results for beginning of cycle [BOC] are similar.) This amount of boron would shut down the reactor. Even assuming that no control rods were inserted, the reactor would be shut down by no less than approximately 900 ppm of boron. Although the worth of boron varies with the reactor state, the staff will assume a 1-percent reactivity worth per 100 ppm of boron. Consequently, the reactor effective multiplication factor, K_{eff}, would be much less than 0.95 for these conditions. Making the conservative assumption that the paint debris would cause a positive reactivity effect by diluting the circulating borated water by 1 percent with unborated water, the reactivity effect (approximately 0.2 percent reactivity) would be significantly less than that required for criticality. The staff concludes, therefore, that the reactivity effect of the paint debris in the circulating borated water would be of no concern for criticality following either a small or a large break LOCA.

3.0 CONCLUSIONS

Based on the preceding evaluation, the staff finds reasonable assurance that debris generated by the failure of all coatings inside the Containment Building under design basis accident conditions will not unacceptably degrade the performance of post-accident fluid systems. The failure of coatings would not result in or contribute to causing, or increasing the consequences of, any design basis accident. Accordingly, such coatings are not required to meet the standards of 10 CFR Part 50, Appendix B. Therefore, TUEC's proposal to amend the FSAR to eliminate the commitment to apply qualified coatings is approved.

Although the ability to achieve safe shutdown and to maintain long-term core cooling is not degraded by the failure of all coatings inside of the reactor Containment Building, the maintenance of a quality coatings system is beneficial.

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*From a mixture of primary system (0 ppm boron) and refueling water storage tank (2000 ppm boron).

Coatings are applied for general cleanliness and to protect metals from corroding. Additionally, smooth coating surfaces are beneficial in meeting ALARA guidelines by providing for expeditious decontamination (NRC Regulatory Guide 8.8). Further, the widespread failure of coatings, while not interfering with safe shutdown or long-term core cooling, can reduce the flexibility of accident responses for low probability events because of concerns with potential flow reduction, although not flow blockage, that can result from coatings failure. For these reasons, while full safety grade standards (those detailed in 10 CFR Part 50 Appendix B) are not required, it is nonetheless important to provide a program to assure "good workmanship quality" for coatings commensurate with their contribution to enhancing plant operation. TUEC, therefore, shall propose a pre- and post-operational coatings testing and surveillance program consistent with the following guidelines.

GUIDELINES FOR A PRE- AND POST-OPERATIONAL
COATINGS TESTING AND SURVEILLANCE PROGRAM
FOR COMANCHE PEAK UNITS 1 AND 2

1.0 Purpose

1.1 The program is intended to provide information on the ability of the applied coatings to reasonably maintain their integrity without separating from the surfaces to which they have been applied.

2.0 Responsibilities

2.1 TUEC shall propose a program which addresses all the criteria set forth herein, and shall establish procedures for the implementation and documentation of that program.

2.2 The NRC will review and approve the program prior to its implementation.

3.0 Method

3.1 TUEC shall develop comprehensive written instructions that describe how coating testing, surveillance, and repairs will be performed.

3.2 These instructions should include the following:

3.2.1 The qualifications and training of the personnel who implement the program to ensure good workmanship.

3.2.2 The tests, surveillance, and repair procedures which will be implemented.

3.2.3 Detailed operational methods for each test, surveillance, and repair procedure to ensure good workmanship.

3.2.4 Instruments and apparatus to be employed and the accuracy requirements, calibration method, and calibration frequency for each.

3.2.5 Frequency of tests and surveillance routines, both in terms of sample sizes and scheduling of repeated testing and surveillance.

3.2.6 Acceptance criteria for each test, surveillance, and repair activity.

3.2.7 Records to be maintained to document all of the above.

4.0 Testing and Surveillance

The program should include the following:

4.1 Preoperational

4.1.1 Testing of coatings as applied to demonstrate their ability to retain adequate adhesion under a range of operating conditions. This should include in-situ temperature and pressure testing with separate evaluation and consideration of the effects of radiation exposure, and concurrent adhesion testing in directly adjacent areas.

4.1.2 Complete and careful visual inspection, using optical aids, such as binoculars, of coated surfaces to detect current or incipient failures. Temporary scaffolding should be used selectively in areas of particular interest.

4.1.3 Information on failure characteristics from in-situ temperature and pressure tests which fail should be assessed to ensure that such characteristics do not adversely affect post-accident fluid systems performance.

4.2 Post Operations

4.2.1 Complete visual inspection, as in 4.1.2 above, at each refueling outage.

4.2.2 Repetition of testing as in 4.1.1 and 4.1.3 at every third refueling outage to detect the capacity of coatings to withstand DBA conditions over time. This inspection should include the use of temporary scaffolding and lighting which is erected and utilized consistent with ALARA guidelines for workers performing these tasks.

5.0 General Requirements for Testing and Surveillance

5.1 Locations of testing and surveillance should be selected so as to provide special attention to Containment Building areas closest to the sumps.

5.2 Specific emphasis should be given to coatings areas which are in the coatings exempt log.

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APPENDIX M

NRC STAFF EVALUATION AND RESOLUTION OF TECHNICAL CONCERNS AND ALLEGATIONS REGARDING PROTECTIVE COATINGS INSIDE OF THE REACTOR CONTAINMENT BUILDING AT COMANCHE PEAK STEAM ELECTRIC STATION UNIT 1

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Attachments

1. Introduction

As construction of the Comanche Peak Steam Electric Station was nearing completion, issues that remained to be resolved prior to the consideration of issuance of an operating license were complex, resource intensive, and spanned more than one NRC office. To ensure the overall coordination and integration of these issues, and to ensure their resolution prior to licensing decisions, the NRC's Executive Director for Operations (EDO) issued a memorandum on March 12, 1984, directing the NRC's Office of Nuclear Reactor Regulation to manage all necessary NRC actions leading to prompt licensing decisions, and assigning the Director, NRC's Division of Licensing, the lead responsibility for coordinating and integrating the related efforts of various offices within the NRC.

The principal areas needing resolution before a licensing decision on Comanche Peak can be reached include: (1) the completion and documentation of the staff's review of the Final Safety Analysis Report (FSAR); (2) those issues in contention before the NRC's Atomic Safety and Licensing Board (ASLB); (3) the completion of necessary NRC regional inspection actions; and (4) the completion and documentation of the staff's review of technical concerns and allegations regarding design and construction of the plant.

Technical concerns and allegations about Comanche Peak, totalling approximately 900, have been raised mainly by the quality assurance/quality control (QA/QC) personnel working or having worked on site. Their job responsibilities involve or involved QA/QC aspects of safety-related structures, systems, and components to determine whether and to what extent such items are manufactured, purchased, stored, maintained, installed, tested, and inspected as required by project documents and procedures. Many of these allegations were made orally to NRC Region IV staff, NRC Comanche Peak Site Resident Inspectors, NRC investigators, or in letters to the NRC, as well as in testimony before the Atomic Safety and Licensing Board (ASLB). Individuals with allegations were also sponsored by the intervenor group Citizens Association for Sound Energy (CASE) and the Government Accountability Project (GAP). General allegations about poor construction work at Comanche Peak were also made in several newspaper articles in the Dallas/Fort Worth, Texas areas.

By the end of April 1984, the staff identified approximately 400 technical concerns and allegations related to the construction of the Comanche Peak facility, including findings by NRC's Special Review Team. (See Section 2.1 below.) During its investigation of a concern or allegation, the TRT identified additional concerns. Interviews with allegers also yielded additional concerns. By December 1984, approximately 600 concerns and allegations had been identified. In addition, approximately 300 allegations were recently provided to the staff by one alleger, bringing the total of concerns and allegations to approximately 900.

These technical concerns and allegations were grouped by subject into the following areas:

- Electrical and Instrumentation
- Civil and Structural
- Mechanical and Piping
- Quality Assurance and Quality Control (QA/QC)
- Coatings
- Test Program
- Miscellaneous

This report covers protective coatings inside the reactor Containment Building and is the third of a series of reports dealing with the NRC staff's efforts to evaluate and resolve the technical concerns and allegations raised by various parties and individuals regarding the Comanche Peak facility. Reports on the staff's evaluation of technical concerns and allegations in electrical and instrumentation and test programs (SSER 7), and in civil and structural and miscellaneous areas (SSER 8), were published in January and February 1985, respectively. An allegation or concern was determined to be without safety significance if, based on technical findings, the assessment showed that a structure, component, or system would perform its intended function. The technical concerns and allegations in the areas of mechanical and piping and QA/QC, as well as the remaining areas of outstanding regulatory actions, will be addressed in future supplements to the Comanche Peak Safety Evaluation Report (SER).

The staff's findings for coatings allegations and concerns are summarized in Section 3 of this Appendix. Attachment 1 to the appendix is a listing of coatings concerns and allegations about Comanche Peak. Details of the assessment and findings on individual concerns or allegations appear in Attachment 2 to this Appendix. Those aspects of the concerns or allegations that pertain to wrongdoing (e.g., falsification of records) were forwarded to the NRC's Office of Investigations (OI) for followup because they are outside the scope of the technical staff's review.

A number of potential violations of NRC rules and regulations have been identified during the course of the TRT investigation. These potential violations have not been addressed in this SSER, but will be reviewed further by the NRC Region IV staff, which will determine appropriate followup actions.

2. Comanche Peak Technical Concerns and Allegations Management Program

2.1 Background

Shortly after the EDO's issuance of the March 12, 1984, directive, the staff found it necessary to (1) obtain current information relative to TUEC's management control of its construction, inspection, and test program and (2) obtain necessary information to establish a management plan for resolution of all outstanding licensing actions. In order to achieve these goals, a Special Review Team (SRT) was formed to conduct an unannounced review of the Comanche Peak plant. The SRT consisted of eight reviewers and one team leader, all from NRC's Region II Office, and a team manager from NRC headquarters. The SRT spent over 800 man-hours, from April 3 to April 13, 1984, performing this review. The SRT concluded that TUEC's programs were being sufficiently controlled to allow continued plant construction while the NRC completed its review and inspection of the Comanche Peak facility.

The SRT review also provided a basis for the development of an NRC management plan for the resolution of all outstanding licensing actions. This plan was approved on June 5, 1984, by the Directors of NRC's Office of Inspection and Enforcement, Office of Nuclear Reactor Regulation, and the Administrator of NRC's Region IV Office. The purpose of the plan was to ensure the overall coordination and integration of the outstanding regulatory actions at Comanche Peak and their satisfactory resolution prior to a licensing decision by the NRC. In accordance with the plan, a Technical Review Team (TRT) was formed to evaluate and resolve technical issues and those allegations that had been identified. On July 9, 1984, the TRT began its 10-week (five 2-week sessions) onsite effort, including interviews of allegers and TUEC personnel, to determine the validity of the technical concerns and allegations, to evaluate their safety significance, and to assess their generic implications. The TRT consisted of approximately 50 technical specialists from NRC headquarters and Regional Offices, as well as NRC consultants. TRT members were divided into groups according to technical discipline. Each group was also assigned a group leader.

2.2 Review Approach and Methodology

2.2.1 Concern and Allegation Tracking System

A tracking system was developed for identifying and listing each concern or allegation. These technical concerns and allegations were grouped according to their topical areas or disciplines, and were listed numerically within each group in the order that they were identified by the TRT. The tracking system included a description of the concern or allegation; its status or the actions taken to resolve it; the nature of the sources of the concern or allegation (i.e., anonymous or confidential); a code for the individual who identified the concern or allegation (instead of the individual's name); the date the concern or allegation was received by the TRT; the source document (e.g., letter, NRC inspection report, hearing transcript, etc.); and cross reference. At the end of each 2-week session, the concern/allegation tracking system was updated, as needed, to reflect the status of each concern or allegation, as well as any new ones that had been added.

2.2.2 Review Methodology

The technical concerns or allegations similar in subject were combined and evaluated as one category. For each concern/allegation or concern/allegation category, an approach to resolution was developed by the cognizant reviewer(s). Each approach to resolution was reviewed and approved by the responsible group leader. The group leaders and reviewers were instructed to:

- develop and maintain a work package for each issue or category of issues that contained or referenced pertinent documentation associated with the issue(s) and the ultimate resolution, including records of interviews and inspections for supporting the final NRC staff decisions regarding the issue(s); and to

- protect the identity of the allegers, as is the NRC's practice. Such efforts included limited and controlled distribution of allegation-related documents; minimal use of names, identifying titles, or position descriptions in written material; enlarged sampling of activities to prevent direct links by non-NRC personnel between the activity under investigation and the alleger; and other indirect approaches toward investigating the allegations.

During TRT onsite sessions, daily meetings were held at the review group level to assess progress, to adjust the inspection and evaluation approach as needed, and to provide a forum for the reviewers to interact with one another or to discuss problems and to arrive jointly at resolutions. Similar daily meetings were also held at the management level where the group leaders interacted with one another and with the Project Director, his assistant and staff.

In evaluating the technical concerns and allegations, the TRT reviewers examined areas in the plant where direct observation could provide information needed for evaluating an allegation or concern. During its onsite sessions, the TRT interviewed the allegers as needed to clarify their concerns or allegations. To the extent possible, the TRT contacted allegers after its onsite review to discuss preliminary TRT findings and to obtain any additional comments from them. (See Section 2.2.3 below.) The TRT also interviewed TUEC and TUEC contractor personnel as was warranted by the evaluation. In addition to these contacts, the TRT reviewed various project documents, including specifications, engineering drawings and analyses, procedures, instructions, NRC Region IV inspection reports, and applicable sections of the Final Safety Analysis Report (FSAR) and NRC regulations pertinent to the allegation or sample selected by the TRT for inspection. The TRT also examined construction records, such as design change authorizations, construction work packages, QC inspection reports, nonconformance reports, deficiency logs, lists and reports, and QC inspector training and certification records. In addition, the TRT reviewed pertinent transcripts from recent ASLB hearings, other sworn testimony of TUEC personnel and former employees, and reports from NRC's Office of Investigations (OI).

Based on these reviews and interviews, the TRT determined the validity of each technical concern or allegation and assessed its safety significance and its potential generic implications. Detailed documentation of the TRT assessment and final determinations of each technical concern or allegation appear in Attachment 2 to this Appendix.

2.2.3 Interviews with Allegers

In January 1984, RIV contracted with Brookhaven National Laboratory (BNL) to provide technical assistance for onsite reviews and technical evaluation of the allegations of deficiencies related to the protective coatings program at CPSES. On April 25, 1984, BNL sent an interim report on protective coatings to RIV. This report requested information from TUEC regarding the Backfit Test Program (BTP), presented BNL's independent test results, and reported BNL's interim findings on TUEC's protective coatings procedures and documentation. On June 13, 1984, BNL sent a draft "Status Report on Protective Coatings Allegations" to RIV. This report provided the current status of BNL's investigation of 60 allegations regarding protective coatings at CPSES. On July 9, 1984, the TRT assumed responsibility for completing the investigation of protective coatings allegations. By memo dated August 7, 1984, from D. Eisenhut to ASLB, the status of the 60 allegations under investigation by BNL were provided to the ASLB. These 60 allegations, plus two additional allegations, formed the basis for the coatings TRT investigation.

The TRT Coatings Group reviewed 62 allegations made by 12 allegers. Many of these allegations were similar or identical; therefore, most allegations were identified by more than one alleger. During its onsite work, the TRT Coatings Group interviewed 3 allegers who were associated with 57 of the 62 allegations to obtain additional information about the issues involved. Attempts to interview individuals associated with the remaining 5 allegations were unsuccessful.

Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. (Each of these interviews was transcribed.) Eight allegers participated in followup interviews, two declined followup interviews, and two could not be found. Seven of the eight allegers who participated in the followup interviews indicated that they were satisfied that the TRT had investigated the concerns. The eighth alleger indicated that although the TRT had investigated most of the concerns, this alleger was not satisfied that allegation AQO-36, which addressed the dispositioning of an NCR, was sufficiently investigated. In the opinion of the TRT Coatings Group, the generic evaluation of coatings traceability (Category 3) encompassed the concerns expressed by this individual.

The TRT Coatings Group substantiated 23 allegations, partially substantiated 20 allegations, and turned over 3 allegations, which involved intimidation or wrongdoing, to the Office of Investigations. Sixteen allegations were not substantiated.

2.3 Communications with TUEC

Whenever the TRT reviewers encountered problems during their evaluations, the TRT Project Director and/or his designee resolved them through discussions with TUEC management onsite. There were also frequent staff-level contacts between TRT members and TUEC personnel during the TRT's onsite activities. In keeping with the NRC practice of promptly notifying applicants of information/evaluation needs that could potentially affect plant safety, the staff held several meetings with TUEC representatives at NRC headquarters toward the end of the TRT's review. These meetings were held to discuss potential safety concerns and to request additional information needed by the TRT to complete its review.

The NRC staff met with TUEC representatives for the first of these meetings on September 18, 1984, to discuss TRT findings for electrical and instrumentation, civil and structural, and test program allegations and concerns. A letter documenting these findings and a request for additional information was issued to TUEC on the day of the meeting. TUEC later submitted the requested information in the form of a proposed program plan, delineating planned actions to address the deficiencies identified by the TRT. The TRT met with TUEC representatives to discuss this proposed program plan on October 19 and 23, 1984. TUEC submitted a partially revised program plan to NRC on November 21, 1984. On November 29, 1984, NRC sent a letter to TUEC containing potential open issues and requesting additional information and proposed program plans for mechanical and piping and miscellaneous allegations and concerns. The letter also advised TUEC of the status of NRC's evaluation of coatings allegations. On January 8, 1985, the NRC issued a letter to TUEC informing them of the TRT's preliminary findings in the construction QA/QC area and requesting a program and schedule for completing a detailed and thorough assessment of the QA issues presented in the letter. A meeting between TUEC and the TRT was held on January 17, 1985, to discuss potential open issues in the QA/QC area. TUEC's proposed program plan for each of the subject areas and its implementation of the plan will be evaluated by the NRC staff prior to the NRC licensing decision on Comanche Peak.

3. Summary of Evaluations

3.1 Scope of Concerns and Allegations

The concerns and allegations in the Protective Coatings area relate to all important aspects of pre-construction and construction activity, including qualification and traceability of coating materials; procedures for surface preparation, application, and inspection; training and qualification of personnel; identification and resolution of deficiencies; the backfit test program; documentation; and improper management pressure upon inspectors. Sixty-two allegations in the coatings area were received and evaluated by the TRT, and each was assigned, as appropriate, to one or more of seven general categories of concern established by the TRT.

In each of the seven general categories, the TRT Protective Coatings Group conducted a generic review of the area of concern, as well as a specific investigation and evaluation of each allegation assigned to the category. The seven categories and descriptions of their associated concerns follow:

Category Number	Subject	Characterization of Concerns and Allegations
1	Backfit Test Program	Inspections for coatings adhesion, thickness, and visible defects were not performed properly. Inspection procedures were inadequate. Inspection results were not properly evaluated and documented.
2	Design Basis Accident (DBA) Qualification Testing	Some protective coating systems applied at CPSES were not DBA qualified.
3	Traceability	The traceability of coating materials was not always maintained. Coating materials were not properly stored. Coating materials were contaminated.
4	Coatings Procedures	Procedures permitted the use of unqualified coating systems. Procedures included instructions which were technically incorrect. Backfit inspection procedures and methods were inadequate. Coatings were applied to surfaces where they should not have been applied. QC inspections were inadequate. Procedures were inadequate to assure traceability.

Category Number	Subject	Characterization of Concerns and Allegations
5	Inspection Reports, Nonconformance Reports, and Design Change Authorizations	Deficiencies were not properly identified, evaluated, resolved, and documented.
6	Coatings Exempt Log	No specific allegations were associated with the coatings exempt log. Instead, the TRT conducted a generic review due to its concerns with the size of the total exempted area and the adequacy of methods used to identify and document exempt items.
7	Training and Qualification	Training and qualification of inspectors and painters were inadequate and not properly documented. Some personnel were not qualified for their assigned tasks.

The TRT did not investigate allegations or concerns on issues of improper management pressure, intimidation, harassment, or wrongdoing. Allegations AQO-16, AQO-56 and AQO-60 dealt with those concerns and were not included in any of the seven categories evaluated by the TRT. Allegation AQO-16 and AQO-56 involved intimidation of coatings QA inspectors by a TUEC civil QC supervisor. These allegations, which were investigated by NRC Office of Investigations (OI) and reported in OI Report 4-83-001, dated August 24, 1983, are currently before the CPSES ASLB.

Allegation AQO-60 involved selective management assignment of certain QC inspectors so that coatings work would pass inspection. As part of its investigation of other technically related allegations, the TRT found that TUEC maintained a log that identified the coatings QC inspector work assignments and the plant area to be inspected. While there were indications of occasional assignment changes, the TRT could make no conclusion of wrongdoing without further investigation. By letter dated August 24, 1984, the TRT Director forwarded the transcribed NRC interview with this alleger to the NRC OI for their review.

Many of the allegations applied to more than one category. Attachment 1 provides a listing of each allegation and the category or categories in which the allegation is reviewed.

3.2 Protective Coatings (PC) Group

The PC Group which performed the onsite investigation and assessment of the allegations consisted of six reviewers, each of whom has had experience with protective coatings in nuclear power plants. Three are associated with a national laboratory; two of the three are consultants with contracting and consulting experience in this area. Two team members from the NRC Office of Nuclear Reactor Regulation (NRR) have experience reviewing protective coatings

in nuclear plants. The seventh reviewer was an inspector from the NRC Region IV office. (Unless otherwise noted, the PC Group will be referred to as the TRT in the remainder of this report.)

3.3 Findings for Protective Coatings Issues

In the Comanche Peak Safety Evaluation Report (NUREG-0797), issued in July 1981, the coating system inside of the Containment Buildings was found to be acceptable based on TUEC's commitment in its FSAR, Section 6.1.2, to meet the positions of Regulatory Guide 1.54, ANSI N101.2, and ANSI N5.12. Coatings which are controlled, applied, and tested to be consistent with these positions are considered to be "Qualified" for a design basis accident (DBA) environment. On June 4, 1984, TUEC proposed to amend the FSAR to eliminate the commitment that coatings inside the Containment Building be qualified. In Appendix L to this supplement, TUEC's proposal to eliminate this commitment that coatings be qualified was found to be acceptable, based on data and analyses which demonstrate that a total failure of protective coatings inside both Containment Buildings would not adversely affect the performance of post-accident fluid systems. Consequently, the staff agreed with TUEC that coating failures do not have safety significance. Therefore, the staff accepted TUEC's position that qualification of these coatings should no longer be required at CPSES.

However, based on TUEC's prior FSAR commitment to provide qualified coatings inside of Containment Buildings, coatings applied before issuance of Appendix L of this supplement were required to have been qualified. TUEC's failure to fulfill that prior commitment indicates deficiencies in the coatings QA/QC program. These deficiencies, although not of safety significance in the coatings area, will be considered in the TRT's overall evaluation of the effectiveness of TUEC's quality assurance/quality control (QA/QC) program.

The TRT finds that all of the allegations except the one related to the backfit test program were not of significant technical concern, either because they were not substantiated or because they involved relatively small areas of coating. The one exception pertains to coatings on miscellaneous steel items which failed the adhesion test. These areas may amount to 6 percent of the total area coated. The generic review and some of the substantiated allegations demonstrated procedural and implementation deficiencies in quality assurance and quality control during the Backfit Test Program.

As a result of deficiencies in TUEC's documentation, design, and engineering functions, the TRT finds that TUEC has not demonstrated that the coating systems applied at CPSES are DBA qualified. In addition to this shortcoming, a number of allegations involving relatively small areas were substantiated in which improper coating sequences or procedures were permitted without adequate engineering justification.

The TRT finds that TUEC's inadequate inspection and documentation practices for coating work prior to November 1981, resulted in loss of material traceability. The Backfit Program tests provide an indication of the quality of the tested coatings, but are not a substitute for coating traceability.

The TRT's generic review and evaluation of individual allegations related to coating procedures has led to the finding that, in many cases, the procedures

were inadequate and resulted in applied coating systems which were either not qualified or not technically viable. These cases include special coating systems for overlaps and repairs, incorrect power tool cleaning instructions, and inadequate instructions for the "nickel test," for final reinspection of repair work, for illumination during visual inspection, for the proper use and testing of compressed air for spray painting, for masking areas that should not be coated, and for maintaining traceability of coating materials. These procedural deficiencies indicate inadequate performance by those responsible for the review and approval of the coating procedures.

The TRT finds that the specific allegations pertaining to the disposition of unsatisfactory inspection reports, nonconformance reports, and design change authorizations are not of significant technical concern, either because they were not substantiated, or because the concerns were resolved properly. However, in its generic review, the TRT finds that, in many cases, nonconformance reports and design change authorizations were dispositioned without documentation of adequate engineering evaluation and justification.

Although there were no specific allegations dealing with the Coatings Exempt Log (CEL), which is a record of unqualified coatings inside the Containment Building, the TRT conducted a generic review of the log because it provided a convenient measure of the total area of plant coatings with unacceptable or indeterminate quality. For these items, which were listed in the CEL, the TRT finds that the determination to include them was made in a conservative manner and the method of estimating the item area was reasonably conservative. However, several sizable areas with coatings of indeterminate quality, for example approximately 54,000 square feet of coatings which may have failed the adhesion test, were not included in the CEL. Before including this additional area, TUEC identified on the CEL approximately 55,000 square feet of unqualified or indeterminate coatings. This value is already considered high by the TRT, and it would be more than doubled by including the additional area. The TRT finds this value (about 20 percent of the total coated area at CPSES) to be excessive when compared to CEL areas reported by other applicants.

Regarding the training and qualification of inspectors, the TRT finds a number of deficiencies. In many cases, records of inspector education, previous experience, training, qualification testing, and certification do not provide evidence adequate to demonstrate the capability of inspection personnel. The allegation that some instructor functions were performed by inadequately qualified personnel was substantiated. The extent to which these deficiencies affected the quality of the completed coating work is indeterminate.

3.4 Overall Assessment and Conclusions

The TRT evaluation of the protective coatings area revealed many specific deficiencies which render a relatively large percentage of the coatings at CPSES unqualified. However, consistent with the guidelines of the Standard Review Plan, Section 6.1.2, TUEC has provided justification that debris generated from the failure of all paint in the Containment Buildings under design basis accident conditions will not adversely affect the performance of post-accident fluid systems. In Appendix L to this supplement, the staff evaluates this justification and concurs with TUEC's conclusions. Therefore, a determination has been made that coatings inside of Containment Buildings do not need to be qualified (see Appendix L).

However, based on TUEC's prior FSAR commitment to provide qualified coatings, those applied before issuance of Appendix L were required to have been applied as qualified coatings. The failure of TUEC to fulfill that prior commitment indicates deficiencies in the coatings QA/QC program.

The number and type of deficiencies found by the TRT evaluation clearly demonstrate serious weaknesses in the coatings QA/QC program in design analysis, material control, instructions, performance and inspection of the work, qualification of personnel, and documentation, all of which rendered the program inadequate to assure compliance with the requirements in effect at the time the work was performed. These deficiencies, although now determined not to be of safety significance in the coatings area, will be considered in evaluating the effectiveness of TUEC's overall QA/QC program.

4. Actions Required of TUEC

The actions required in the protective coatings area reflect the findings and conclusions of Appendix L to this supplement. The TRT does not recommend any actions to remedy deficiencies in the coatings applied at CPSES. However, actions are required to document the status of existing coatings so that future inspection and test programs implemented to comply with the guidelines of Appendix L to this supplement can be based on known coating conditions.

4.1 Backfit Test Program (See Coatings Category 1)

- Apply the Elcometer calibration correction to the data for the 4714 adhesion tests covering 2189 miscellaneous steel items tested to establish a more reliable estimate of the adhesion test failure rate. This revised analysis should include a statistical analysis showing the 95 percent confidence upper limit of the failure rate for all the miscellaneous steel items inside the Containment Building.

- Analyze the corrected data to establish a more reliable estimate of the fraction of tested miscellaneous steel coated surface that failed the adhesion test acceptance criterion. Enter the resulting failed areas in the protective coating exempt log. (See Coatings Category 6.) The coating exempt log will be used in planning future inspections of coatings consistent with the guidelines of Appendix L.

4.2 Traceability (See Coatings Category 3)

- CPSES Nonconformance Reports (NCRs) C-81-01724 and C-81-01673 provide "use-as-is" dispositions for discrepant coating materials with inadequate technical justification for the disposition. Accordingly, provide adequate technical justification to demonstrate the acceptability of the batches of coating materials listed in these NCRs or, alternatively, identify and quantify the areas where these batches were used and place these areas in the coatings exempt log. Additionally, review all other NCRs which report discrepant or irregular conditions in coating materials. For any such NCRs which were dispositioned "use-as-is," identify the batches and provide adequate technical justification for their acceptance, or identify and quantify the areas where the batches were used and place these areas in the coatings exempt log.

  The coating exempt log will be used in planning future inspections of coatings consistent with the guidelines of Appendix L to this supplement.

4.3 Coatings Procedures (See Coatings Category 4)

- The TRT found deficiencies in procedures and instructions for coating work and related inspection activities during the construction phase, which rendered them inappropriate or inadequate for determining satisfactory accomplishment of important activities. The TRT also found that the procedure review and approval system was inadequate to detect and correct these deficiencies.

Accordingly, make the necessary changes to the procedure review and approval system to assure review and approval by technically qualified individuals to prevent recurrence of the types of deficiencies discussed in Coatings Category 4, and to assure that procedures are reviewed for consistency and clarity. Apply this revised review and approval system to the issuance and revision of all procedures which will govern future coating work, inspection, and testing at CPSES, consistent with the guidelines of Appendix L to NUREG-0797, Supplement 9.

4.4 Coatings Exempt Log (See Coatings Category 6)

- Provide updated estimates of the additional items including those detailed in Coatings Category 6 to be entered into the exempt log. Although all coatings are now considered exempt, maintain the CEL separately to identify all items which did not meet the requirements in effect at the time the coating work was performed. This log will be used in planning future inspection of coatings consistent with the guidelines of Appendix L of NUREG-0797, Supplement 9.

ATTACHMENT 1

LIST OF TECHNICAL CONCERNS AND ALLEGATIONS IN THE PROTECTIVE COATINGS AREA

Allegation Number	Characterization	Category	Page Number
AQO-1	Imperial coatings (Southern Imperial Coatings of New Orleans) applied in the sequential order #11S/1201/11S/1201 or #11S/1201/11/1201, in accordance with B&R Procedure CCP-40, Paragraph 4.3.1.2, are not DBA qualified.	2, 4	M-49, M-75
AQO-2	Repair coating systems applied in sequences which are different from the original application sequences, as discussed in non-conformance report (NCR) #C83-01752, June 23, 1983, are not DBA qualified.	2, 4	M-49, M-75
AQO-3	Carboline Phenoline 305 (P-305) applied over another manufacturer's epoxy coating, in accordance with design change authorization (DCA) #17,142, Revision 2, is not DBA qualified.	2, 4	M-49, M-75
AQO-4	Carboline Carbo Zinc 11 (CZ-11) topcoated with Imperial 1201, in accordance with DCA #12,374, Revision 1, is not DBA qualified.	2, 4	M-49, M-75
AQO-5	P-305 applied over Ameron Dimetcote 6 (D-6), in accordance with CPSES Procedure #CCP-30A, Revision 2, Paragraph 1.3.1, is not DBA qualified.	2, 4	M-49, M-75
AQO-6	Imperial Nutec 11S surfacer applied over foreign objects embedded in concrete, in accordance with CPSES Procedure #CCP-40, Revision 5, Paragraph 4.1.1.3, is not DBA qualified.	2, 4	M-49, M-75
AQO-7	CPSES NCR #C83-01986 provides a repair disposition for cracking and flaking of concrete coatings which will not remedy the cause of the deficiencies.	4, 5b	M-75, M-107

ATTACHMENT 1 (Continued)

Allegation Number	Characterization	Category	Page Number
AQO-8	CPSES procedure #CCP-30, Revision 11, allows inorganic zinc primer to be applied over zinc residue which will cause adhesion problems and prevent galvanic action.	4	M-75
AQO-9	Inorganic zinc primer in some locations was applied in three coats contrary to procedure QI-QP-11.4.5, Revision 27, and is therefore not DBA qualified.	2, 4	M-49, M-75
AQO-10	Coatings applied to surfaces which were prepared by power tool cleaning were smoothed or polished and thus do not have adequate surface profile to assure adherence at DBA conditions.	2, 4	M-49, M-75
AQO-11	Primer applied to a thickness of 0.5 mils, in accordance with DCA #18,489, may be too thin to be qualified for a DBA.	2, 4, 5c	M-49, M-75, M-111
AQO-12	Imperial coating system 11S/1201/11S/1201 applied at a thickness of 102 mils, in accordance with CPSES Procedure CCP-40, Revision 5, Paragraph 4.3.1.2, may not be qualified for a DBA.	2, 4	M-49, M-75
AQO-13	Coatings applied in the reactor core cavity which will be subjected to higher levels of neutron and gamma exposure than coatings in other areas may fail during a DBA.	2	M-49
AQO-14	Inspectors are prevented from writing NCRs and must instead write unsatisfactory IRs. Once written, anyone can sign off on NCRs and IRs. A past QC supervisor voided many NCRs. Due to a poor tracking system, IRs can be lost.	5a, 5b	M-103, M-107
AQO-15	CZ-11 or Carboline 191 primer (191P) applied over P-305, and P-305 applied over Imperial 1201, in accordance with CPSES Procedure CCP-30, Revision 11, Paragraph 4.4.3.0, are not DBA qualified.	2, 4	M-49, M-75

ATTACHMENT 1 (Continued)

Allegation Number	Characterization	Category	Page Number
AQO-16	QC inspectors are being pressured and intimidated, which may result in coatings deficiencies.	*	
AQO-17	Tests of the cleanliness of compressed air used for spray application of coatings were invalidated due to the practices of production personnel.	4	M-75
AQO-18	Inspectors were not allowed to identify visual defects during backfit inspections.	1, 4	M-23, M-75
AQO-19	Backfit inspection procedures are vague.	1, 4	M-23, M-75
AQO-20	Adhesion testing of the protective coatings was not performed properly during the backfit test program.	1, 4	M-23, M-75
AQO-21	Adhesion test data were not corrected for calibration error.	1	M-23
AQO-22	Backfit program adhesion testing is performed by coatings inspectors prior to completing training.	7	M-121
AQO-23	The coatings QC program at CPSES is inferior to such programs at other nuclear power plant project because it does not permit use of the standard tests which have been used on other projects.	4	M-75
AQO-24	Coatings have been placed over rusty, scaly, unprepared metal surfaces inside pipe supports made of tube steel without end-caps and may come off during an accident.	4, 5c	M-75, M-111
AQO-25	A seal coat which should have been rejected was improperly accepted by QC personnel prior to the finish coat being applied.	5a	M-103
AQO-26	DCAs are not controlled.	5c	M-111

*This allegation is associated with intimidation and has been transferred to the OI.

ATTACHMENT 1 (Continued)

Allegation Number	Characterization	Category	Page Number
AQO-27	DCAs are originated and approved by Engineering without QA/QC input.	5c	M-111
AQO-28	DCAs are written to make conditions acceptable so NCRs will not be written.	5c	M-111
AQO-29	DCAs are written rather than reworking deficient areas to overcome problems that are identified by NCRs.	5c	M-111
AQO-30	DCAs are used to downgrade surface preparation and specification requirements from safety to nonsafety.	5c	M-111
AQO-31	QC management told inspectors "not to worry" about difficult access areas, and to "do the best you can."	4, 5c	M-75, M-111
AQO-32	Reading list contents were changed after inspectors had signed the list.	7	M-121
AQO-33	A lead coatings inspector lacked the qualifications to properly perform his duties.	7	M-121
AQO-34	The requirements of American National Standards Institute (ANSI) Standard N45.2.2-1978 were not met for coating material storage.	3, 4	M-65, M-75
AQO-35	Workmanship was poor because painters lacked the qualifications necessary to produce quality work; and painter certification documentation was deficient.	7	M-121
AQO-36	The traceability of coatings materials was not always maintained.	3, 4	M-65, M-75
AQO-37	The backfit test program was improperly performed. Maps were incorrect and documentation was forged and falsified.	1	M-23,
AQO-38	The method used at CPSES to remedy high dry film thickness (DFT) of CZ-11 will burnish the primer and result in poor adhesion of the topcoat.	4	M-75

ATTACHMENT 1 (Continued)

Allegation Number	Characterization	Category	Page Number
AQO-39	Applied P-305, one and two years old was topcoated with new P-305 with little or no surface preparation.	4	M-75
AQO-40	Residues resulting from power tool cleaning of surfaces were removed by improper methods which could leave contamination or debris under the top coat.	4	M-75
AQO-41	An improper cleaning solution which was used to wipe surfaces immediately prior to repairs left behind prohibited impurities.	4	M-75
AQO-42	Imperial 11S and 1201 were applied over duct tape and foam rubber on Richmond Inserts resulting in the appearance of a solid wall where, in fact, holes exist.	4	M-75
AQO-43	The methods used at CPSES to verify the cure of inorganic zinc primers are not adequate, and inorganic zinc primers are not properly cured prior to topcoating.	4	M-75
AQO-44	The "nickel test" for verifying the cure of inorganic zinc primers prior to topcoating was not performed properly.	4	M-75
AQO-45	Repairs of defects have been accomplished with no reinspection of the repairs.	4	M-75
AQO-46	Some adhesion test samples showed unacceptable substrate conditions, including rust.	1	M-23
AQO-47	QC inspectors were instructed to perform approximately 25 Elcometer adhesion tests, in violation of written instructions.	1	M-23
AQO-48	Coatings were applied over seismic joints which were filled with foam and were not to be coated.	4	M-75
AQO-49	Overspray was allowed and was commonplace in areas which had been inspected previously.	4, 5a	M-75, M-103
AQO-50	Coatings have been applied over s[illegible] substrates without quality con[illegible] inspection.	5a	M-103

ATTACHMENT 1 (Continued)

Allegation Number	Characterization	Category	Page Number
AQO-51	Excessive thinning of P-305 resulted in a weak and brittle film and made it impossible to obtain a Tooke gauge reading.	4	M-75
AQO-52	Coatings have been applied over concrete substrates without QC inspection.	5a	M-103
AQO-53	QC inspectors have been denied the opportunity of writing Request for Information or Clarification (RFIC).	5a	M-103
AQO-54	During the Backfit Test Program, only the first unsatisfactory DFT reading was recorded even if subsequent readings were further out-of-specification; thus, adversely affecting the trend analysis.	1	M-23
AQO-55	Areas identified during the Backfit Program as requiring coatings removal did not have the coatings removed.	1	M-23
AQO-56	Original documentation for the Backfit Program was destroyed by QC management.	*	
AQO-57	An area at the 860-foot elevation in Unit 2 had coatings applied over filth.	5a	M-103
AQO-58	CPSES QC inspection procedures require that inspections be performed "at arm's length" and with inadequate lighting.	4	M-75
AQO-59	Substandard coatings on the liner plate were accepted by a QC inspector.	5a	M-103
AQO-60	Coatings inspectors were selectively sent to various inspections so that areas would pass inspection.	*	
AQO-61	Prospective inspectors were sometimes trained by unqualified instructors and management had been aware of the practice.	7	M-121

*This allegation is associated with wrongdoing and has been transferred to the OI.

ATTACHMENT 1 (Continued)

Allegation Number	Characterization	Category	Page Number
AQO-62	Some paint used at CPSES in Service Level I areas was contaminated with grease and oil prior to application and was applied anyway.	3, 4	M-65, M-75

ATTACHMENT 2

ASSESSMENT OF INDIVIDUAL TECHNICAL CONCERNS AND ALLEGATIONS IN THE COATINGS AREA

1. Allegation Category: Coatings 1, Backfit Test Program

2. Allegation Number: Parts of AQO-18, AQO-19, AQO-20, AQO-21, AQO-37, AQO-46, AQO-47, AQO-54, AQO-55 and AQO-56.

3. Characterization: It is alleged that:

   - Visual defects were not identified during backfit inspections (AQO-18).
   - Backfit inspection procedures were vague (AQO-19).
   - Adhesion testing of the protective coatings was not performed properly (AQO-20).
   - Adhesion test data were not corrected for calibration error (AQO-21).
   - An area stated to have satisfactory documentation, in fact, had primer coatings exceeding the allowed thickness (AQO-37a).
   - Maps for the backfit test program were incorrect (AQO-37b).
   - Documentation for the backfit test program was forged and falsified (AQO-37c).
   - QC inspectors completed inspection reports (IRs) without performing the inspections (AQO-37d).
   - Unacceptable substrate conditions were observed through Tooke gauge tests (AQO-46).
   - Adhesion test dollies used during the backfit test program were observed to have rust adhering to the paint (underside) at the completion of the test (AQO-46b).
   - Twenty-five adhesion tests were performed in violation of written instructions (AQO-47).
   - During the backfit test program, only the first unsatisfactory reading was recorded, which adversely affected the trend analysis (AQO-54).
   - Areas identified during the backfit test program as requiring coatings removal did not have the coatings removed (AQO-55).
   - Original documentation for the backfit test program was destroyed by QC management (AQO-56).

4. Assessment of Safety Significance: In order to assess the individual allegations characterized above, the NRC Technical Review Team (TRT) re-

viewed the background and scope of the backfit test program (BTP) and independently evaluated the program test results as presented below. The TRT assessment of the individual allegations follows in Section 4.d.

a. Backfit Test Program Background and Scope

(1) Background: In 1981, Region IV (RIV) of the NRC inspected protective coatings at the Comanche Peak Steam Electric Station (CPSES). As a result of this inspection, which culminated in the issuance of Inspection Report (IR) 81-15, RIV issued a Notice of Violation regarding the failure of Texas Utilities Electric Company (TUEC) to follow quality assurance program procedures for the inspection of protective coatings. Specifically, from late September 1979 through October 1981, documentation for protective coatings inspections either was not maintained or was incomplete.

In response to the Notice of Violation, TUEC, in a letter to NRC dated November 19, 1981, proposed instituting a backfit test program (BTP) and documented the cited discrepancies as nonconforming conditions. TUEC also proposed a complete review of existing records and a reinspection (using destructive testing) of coated areas for which documentation was missing or discrepant. The reinspection was to be based on a statistically sound sampling plan. Both dry film thickness tests (Tooke gauge tests) and adhesion tests (Elcometer tests) were to be used to evaluate the condition of the applied coatings, and any discrepant areas were to be clearly identified and corrected in accordance with approved procedures. On January 19, 1982, the NRC responded to TUEC's November 19, 1981, letter. The NRC had no questions at that time, and informed TUEC that they would review the corrective actions during a future inspection.

In January 1984, RIV contracted with Brookhaven National Laboratory (BNL) to provide technical assistance for onsite reviews and technical evaluation of the allegations of deficiencies related to the protective coatings program at CPSES. As part of BNL's review work at CPSES, the NRC requested that BNL perform some independent testing of the protective coatings. These independent tests are discussed later in this report.

On April 25, 1984, BNL sent an interim report on protective coatings to RIV. This report requested information from TUEC regarding the BTP, presented BNL's independent test results, and reported BNL's interim findings on TUEC's protective coatings procedures and documentation. By memo dated May 22, 1984, from D. Eisenhut to the ASLB, BNL's April 25, 1984, interim report was provided to the ASLB. On June 13, 1984, BNL sent a draft "Status Report on Protective Coatings Allegations" to RIV, providing the current status of BNL's investigation of 60 allegations regarding protective coatings at CPSES. On July 9, 1984, the TRT assumed responsibility for the investigation of the protective coatings allegations, based on the EDO directive of March 12, 1984. By memo dated August 7, 1984, from D. Eisenhut to the ASLB, the status of the 60 allegations under investigation by BNL were provided to the ASLB. These 60 allegations plus 2 additional allegations formed the basis for the TRT coatings investigation. In

BNL's April 25, 1984, interim report of their investigation, deficiencies were noted in "Testing, Procedures, Documentation/Design Control." The BNL interim report concluded that: "The coatings procedures and design control for coatings at CPSES appear to be inadequate to assure the specification of proper coatings systems and the application of coatings, once they are specified."

In addition to the review of individual allegations, the TRT conducted an independent generic review of coatings, as discussed in Section 3.1 of this supplement. The TRT overall assessment and conclusions, based on its generic review (Section 3.4 of this Appendix), states:

> The number and type of deficiencies found by the TRT evaluation clearly demonstrate serious weaknesses in the coatings QA/QC program in design analysis, material control, instructions, performance and inspection of the work, qualification of personnel, and documentation; all of which rendered the program inadequate to assure compliance with the requirements in effect at the time the work was performed.

Therefore, the TRT's conclusions are in substantial agreement with BNL's interim assessment, even though the TRT did not compare each allegation it assessed with those assessed in BNL's interim report.

The TRT substantiated or partially substantiated most allegations, including those examined by BNL. However, the TRT found that none of the allegations except the one related to the backfit test program were of significant technical concern, either because they were not substantiated or because they involved relatively small areas of coating. The one exception pertains to coatings on miscellaneous steel items which failed the adhesion test. These areas may amount to 6 percent of the total area coated.

(2) Scope: The purpose of the BTP was to review and reinspect the coated steel liner, concrete, and miscellaneous steel for which coatings documentation was missing or discrepant. Tooke gauge tests were used to measure the dry film thickness (DFT) of the primer and topcoat, and Elcometer adhesion test results were used to determine if protective coatings adequately adhered to the substrate. TUEC also selected a 200-psi pull criterion for the adhesion test, presented in Section 6, "Physical Properties Tests," of ANSI Standard N5.12-1974, "Protective Coatings (paints) for the Nuclear Industry." TUEC intended to use the DFT and adhesion test data in lieu of the missing and discrepant documentation.

It is the TRT's opinion that if DBA-qualified paint, as defined in the introduction to Appendix L, was applied and its traceability was maintained, the BTP, properly administered, could provide useful, indirect information on the quality and design basis accident (DBA) survivability of the coating work with missing or discrepant documentation. The DFT tests could demonstrate that the protective coatings were applied in the same thickness ranges (for primer and topcoat) as the DBA qualification tested samples. Adhesion tests

provide data which indirectly demonstrate the adequacy of surface preparation, in that the primary purpose of surface preparation is to provide good coatings adhesion. The adhesion tests also provide some assurance that application and curing of the coatings are adequate to produce satisfactory coating film integrity and internal strength. The adhesion criterion of 200 psi is appropriate, because this criterion applies to physical properties testing of DBA qualification test samples in accordance with ANSI N5.12.

b. Evaluation of Backfit Test Program (BTP) Results

(1) General: In its review of BTP inspections and tests, the TRT paid particular attention to the adhesion test results because they provided the most direct indication of coating adherence to Containment Building surfaces under accident conditions, the primary safety concern related to coatings.

Adhesion testing was performed using an Elcometer adhesion tester, which measures the force required to pull a protective coating off the coated surface. The Elcometer model used by TUEC inspectors for the BTP had a total range of 0 to 1,000 psi, and could be read in the field with a precision of approximately 50 psi. The Elcometer readings tended to read high after repeated use; therefore, the Elcometers were periodically recalibrated by deadweight testing in the onsite Brown & Root instrument shop.

The partial results of the adhesion tests and dry film thickness tests on the Containment Building steel liner, the concrete surfaces, and the surfaces of miscellaneous steel components in Unit 1 were reported by correspondence from L. Bielfeldt of TUEC to D. Lurie and L. R. Abramson of NRC, dated March 29, April 17, and April 23, 1984. The failure rates (Elcometer readings below 200 psi) were very low. For the Containment Building liner, only 2 out of 405 paint samples failed; for the concrete surfaces, there were no failures in 1,691 readings; and for the miscellaneous steel surfaces, there were 20 failures in 1,517 readings. As discussed in detail below, the DFT test failures rates were also low. On the basis of these low failure rates, TUEC, in a memorandum from R. G. Tolson to its inspection staff, on February 10, 1984, discontinued all routine destructive testing (adhesion tests and Tooke gauge coating thickness tests).

In a letter to the NRC dated February 15, 1984, TUEC referred to verbal notification on January 16, 1984, to Mr. R. G. Taylor of the NRC, of a "deficiency regarding an error in the tolerances used in the calibration of the adhesion tester." At the July 11, 1984, site meeting, TUEC briefed the TRT on the overall scope of the coating backfit test program. R. Tolson (TUEC) informed the team of the discrepancy in calibrating Elcometers used for the coating adhesion test. This discrepancy, which was discovered after most of the BTP adhesion tests were completed, would allow in-plant test results to be too high by as much as 200 psi. Thus, any Elcometer reading less than 400 psi represented a potentially failed area of coatings.

After learning of this deficiency, the NRC, by attachment to an NRC meeting notice memorandum dated July 27, 1984, requested that TUEC provide the TRT with corrected adhesion test data and analyses of failure rates for the containment liner, concrete, and miscellaneous steel. In the TRT's opinion, the corrections to the Elcometer readings could reasonably be made from calibration data available in the instrument shop for each Elcometer for each date on which it was checked.

Part of this information was provided by TUEC in a letter to NRC Region IV, dated July 16, 1984, which was prepared in response to a previous NRC request of May 23, 1984. TUEC's correspondence contained the calibration data for each Elcometer and the majority of the protective coatings inspection reports (PCRs) for the backfit test program. (Although TUEC submitted 278 PCRs, its liner map indicated that there were 339 PCRs.) TUEC's transmittal letter stated that the package contained results for 869 adhesive tests for the liner, 2,128 tests for the concrete, and 4,714 tests for the miscellaneous steel. The PCRs recorded the original, uncorrected adhesion data and the dry film thickness data.

A list of PCRs for the Containment Building steel liner coatings with adhesion test readings below 200 psi after correction, and an analysis of the failure rate, were transmitted to NRC by TUEC in a letter dated August 14, 1984; the letter included an interoffice memorandum from R. C. Levine to R. G. Tolson, dated August 10, 1984. For the concrete surfaces in the Containment Building, another TUEC interoffice memorandum, from R. G. Tolson to file, dated September 10, 1984, was submitted to the TRT, and provided a list of PCRs with adhesion test readings below 200 psi after correction, and an estimate of failure rate.

(2) Liner Plate Test Results

(a) Adhesion Testing. TUEC found that 51 out of 869 adhesion test readings, or 5.9 percent, for the coatings on the Containment Building liner were below 200 psi after correction for calibration error. The failed area, calculated by summing the areas corresponding to each failed reading, was 5,148 square feet, or 3.5 percent of the total liner surface, which TUEC estimated to be 145,088 square feet. In this evaluation, the TRT expresses failure rates in terms of area failed rather than in terms of number of failed tests because each test may represent a different number of square feet. Test areas typically range from approximately 20 square feet to 145 square feet.

The TRT believes that TUEC's estimate of total liner surface is too high. Considering the liner surface as a cylinder (diameter 135 feet, height 192 feet) topped by a hemisphere (diameter 135 feet), the surface area is 110,000 square feet. TUEC personnel interviewed by the TRT were unable to explain why they calculated the area to be 145,088 square feet.

TUEC also estimated that 96 percent of the total liner surface was backfit tested. Based upon its review of the liner surface

backfit test map, the TRT found the 96 percent estimate to be reasonable, so that the liner surface tested for adhesion would be 106,000 square feet. Using this figure, 4.8 percent of the area tested failed the adhesion test.

The TRT independently assessed the liner failure rate from the original adhesion data after correcting the readings according to the Elcometer calibration data from the instrument shop. The TRT found that, after correction, 36 adhesion test readings (out of a total of 834) were below 200 psi, giving a test failure rate of 4.3 percent. The failed area, calculated by summing the areas corresponding to each failed reading, totalled 3,092 square feet or 2.9 percent of the area tested.

The package of PCRs delivered by TUEC contained only 278 PCRs, with 3 adhesion readings recorded on each PCR, for a total of 834 adhesion test readings. The TUEC transmittal letter of August 14, 1984, for the package and the memorandum of August 10, 1984, referred to 869 adhesion test readings, which corresponded to about 290 PCRs, assuming that the usual 3 readings were reported on each PCR. However, 339 areas on the Containment Building liner map provided by TUEC were labeled with different PCR numbers. Apparently, not all of the liner PCRs were included in the package delivered to the TRT, nor were they included in the group discussed in the August 10, 1984, TUEC memorandum. TUEC personnel interviewed by the TRT were unable to account for the discrepancy, and agreed that the 339 areas on the liner map represented the total number of PCRs.

On the assumption that the average liner area per PCR was the same for the missing PCRs as it was for those delivered to the TRT, the adhesion-tested area would be 106,000 square feet multiplied by 278/339, or 87,000 square feet. Using this area, the TRT found that 3.6 percent of the liner area tested failed the adhesion test. The TRT assumed the same failure rate for the liner area represented by the missing PCRs. When a similar correction is applied to the area failure rate calculated by TUEC, the TUEC failure rate becomes 5.9 percent of the tested area. A more accurate estimate of the area represented by the missing PCRs can be obtained by locating the missing PCR areas on the liner map and summing them. Without the missing PCRs themselves, an accurate estimate of adhesion test failure rate for these areas cannot be obtained.

To account for the discrepancy between the number of failures found by the TRT, 36 or 3.6 percent, and by TUEC, 51 or 5.9 percent, the TRT examined the methods of correcting the original adhesion data for calibration error. The TRT determined that TUEC was more conservative (used larger corrections) in correcting for calibration errors, so that some adhesion test readings which were below 200 psi after the TUEC correction were above 200 psi after the TRT correction.

(b) Dry Film Thickness (DFT) Testing. A second concern evaluated in determining the quality of liner coatings for the BTP was the

dry film thickness (DFT) of the primer coat and of the total coating system. These thicknesses are measured with a Tooke gauge. With this device, a sharp V-shaped cut through the coatings to the substrate is made, after which the edges of the cut are examined with the optics of the instrument to determine the minimum, maximum, and average thicknesses of the primer and of the total coating system.

The original TUGCO backfit inspection procedure for protective coatings on steel, QI-QP-11.4-23, issued on November 19, 1981, specified the following acceptable thickness ranges:

Coating	Single Reading, Mils	Average of 5 Readings, Mils
Primer - Carboline CZ-11	1.5 - 5.5	2.0 - 4.5
" - Ameron D6	1.5 - 5.5	2.0 - 5.0
Total System - Primer & Phenoline 305 topcoat	7.0 -11.5	7.0 -11.0

A majority of the liner PCRs reported at least one DFT value outside the original specifications. Subsequent revisions of the procedures broadened the acceptable thickness ranges. The latest version (Revision 13, dated April 18, 1984) listed the following ranges:

Coating	Single Reading, Mils	Average of 5 Readings, Mils
Primer - Carboline CZ-11	1.5 - 8.0	1.5 - 7.0
" - Ameron D6	1.5 - 7.0	1.5 - 7.0
" - Carboline 191	1.5 - 7.0	1.5 - 7.0
Total System - Primer & Phenoline 305 topcoat	From full "hiding" by topcoat to less than 15.0	From full "hiding" by topcoat to less than 13.0

(TRT technical concerns involved in enlarging the acceptable range of thicknesses, as related to DBA qualifications of coatings, are discussed in Coatings Category 2 of this Appendix.)

Even after the DFT specifications were broadened, many of the liner PCRs contained one or more DFTs outside the allowable range, most often on the low side for the total system (primer plus topcoat). As a consequence, according to interviews with TUEC QC personnel, nearly all of the liner coatings in place at the start of the backfit test program were reworked. The TRT review of records of the disposition of NCRs confirmed rework for many liner areas. The repairs were performed in accordance with the approved Texas Utilities Generating Company (TUGCO) repair procedure (QI-QP-11.4-23) and were reinspected.

A few small, unrepaired liner areas (totalling about 110 square feet) were placed in the coatings exempt log (CEL) as Items 8

to 18. (The TRT review of the CEL is discussed in Coatings Category 6 of this Appendix.)

When the repairs were completed, less than one percent of the Containment Building liner coatings did not meet the DFT specifications of TUGCO procedure QI-QP-11.4-23, Revision 13.

(3) Concrete Test Results

(a) Adhesion Testing. As stated in 4.b(1), TUEC provided the results of 2,128 adhesion tests on concrete coatings (634 PCRs, with 1 to 5 adhesion tests recorded on each) in their letter dated July 16, 1984. TUEC stated that the 2,128 tests represented approximately 50 percent of the concrete surfaces in the Containment Building. The concrete surfaces not subjected to backfit inspection were: (1) areas not coated at the time of backfit inspection; (2) areas inaccessible to test equipment; and (3) areas not inspected (due to termination of the test program on February 10, 1984).

As discussed in 4.b(1), TUEC's initial reports on the adhesion tests on concrete indicated no failures in 1,691 tests. When the Elcometer readings recorded on the PCRs were corrected for calibration error, TUEC (in a memorandum from R. G. Tolson to File, dated September 10, 1984) reported 65 adhesion test readings out of 2,128 tests with values below 200 psi, which corresponds to a failure rate of 3.1 percent. TUEC provided neither a calculation of total concrete area with coatings failing the adhesion test nor a calculation of the percentage of concrete area where coatings failed the adhesion test. The concrete surfaces, because of their more complicated geometry, are less amenable to accurate determination of the tested surface area than the Containment Building liner surfaces. Since test procedure QI-QP-11.4-24 called for approximately one adhesion test and one set of DFT readings per 100 square feet of concrete surface, the failure rate in terms of area can be approximated by the test failure rate.

The TRT did not conduct a complete independent analysis of the massive amount of adhesion data for the concrete coatings. Instead, the TRT elected to restrict its audit of the adhesion data to the coatings on the interior surfaces of the concrete compartments surrounding steam generators No. 1 and No. 4. These surfaces were selected, in part, because of their proximity to the Unit 1 Containment Building sump screens. However, an analysis subsequently performed for Appendix L of this supplement demonstrated that this debris would not reach the sump screens.

Areas of the interior walls of steam generator compartments No. 1 and No. 4, which had been backfit-inspected, were delineated and labeled with PCR numbers on TUGCO drawings of these surfaces (drawings PCRM-018A1 and PCRM-018B1 for compartment 1; drawings PCRM-019A1 and PCRM-019B1 for compartment 4). From the data recorded on each of these PCRs (20 in compartment 1 and 11 in compartment 4), the TRT tabulated the date of testing, the

Elcometer readings, the Elcometer used, and the area tested. For the concrete adhesion tests, the number of adhesion tests per PCR varied from 2 to 5, with approximately one test per 100 square feet of sampled area. The TRT corrected the original adhesion test results for calibration error from the calibration data provided by the instrument shop. After correction, the TRT found 8 adhesion tests reading 200 psi or lower out of a total of 116 tests, giving a test failure rate of 6.8 percent. Three of the eight failures were within 10 psi of 200 psi; if these were not counted as failures, the test failure rate would be 4.3 percent, which is in better agreement with TUEC's estimate of 3.1 percent.

The total failed area, calculated by summing the areas corresponding to the failed tests, was 745 square feet. The TRT assumed in calculating this area and the total tested area that each recorded set of DFT tests corresponded to 100 square feet. The total tested area represented by the 31 PCRs was approximately 11,000 square feet. The TRT, therefore, found that 6.8 percent of the area of protective coatings on the interior concrete surfaces of steam generator compartments Nos. 1 and 4 failed the adhesion test. If the three borderline failures were neglected, the failure rate by area would be 4.0 percent. Based on TUEC's estimate of 285,000 square feet for total concrete surface area, the TRT's 6.8 percent failure rate corresponded to a failed concrete coated area of 19,400 square feet, whereas TUEC's 3.1 percent failure rate corresponded to 8,800 square feet.

The TUEC letter of July 16, 1984, stated that approximately 50 percent of the concrete area was backfit inspected. The TRT estimated from the drawings of steam generator compartments Nos. 1 and 4 that the total area of the internal surfaces was approximately 20,200 square feet. The backfit-tested area was approximately 11,000 square feet, or approximately 55 percent of the total area, which was consistent with the TUEC estimate that 50 percent of the total concrete area in containment was backfitted.

(b) Dry Film Thickness (DFT) Testing. The original TUGCO backfit inspection procedure for protective coatings on concrete, QI-QP-11.4-24, Revision 0 (February 5, 1982), specified the acceptable coating thickness range for Reactic 1201 topcoat on concrete as a minimum of 3 mils and a maximum of 12 mils. As required by procedure, five scratches, spaced randomly over each 100 square feet of the sampled concrete area, were made with the Tooke DFT tester. A single reading was selected as representative of coating thickness of each scratch. The "minimum" recorded on the PCR was the lowest of the five readings; the "maximum" was the highest; and the "average" recorded was the average of the five. The permissible "maximum" thickness limit was expanded to 16 mils in Revision 3 of the procedure on June 29, 1982.

In correspondence dated April 17, 1984, from L. Bielfeldt of TUEC to D. Lurie and L. R. Abramson of NRC, TUEC reported that 101 recorded DFT readings out of a total of 4,623 on concrete coatings failed to meet the thickness specifications given above, giving a test failure rate of 2.2 percent. Most of these failures were for low topcoat thickness.

In a manner similar to that for the adhesion tests on concrete, the TRT restricted its audit of the backfit DFT tests to the coatings on the interior concrete surfaces of steam generator compartments Nos. 1 and 4. The TRT examined the DFT data recorded on the 31 PCRs for these surfaces and found 10 recorded DFT readings out of a total of 297 which failed, giving a failure rate of 3.3 percent. Only one of the failed tests exceeded the allowable thickness; the remaining failures had thicknesses below the allowable 3 mils minimum.

It is not clear why the DFT failure rate in steam generator compartments Nos. 1 and 4 was greater than the overall DFT failure rate reported by TUEC. The failure rate may be high because the small area sampled was not representative of the total concrete area. In any case, according to statements by TUEC QC personnel and the TRT inspection of the disposition of NCRs for many concrete areas, nearly all of the concrete areas with failed DFTs were repaired according to TUGCO procedure QF-QP-11.4-24 until the DFTs were satisfactory. The TRT conducted a random sampling of IRs and travelers which confirmed this. The principal exceptions were the coatings on the concrete surfaces of the reactor cavity (3,135 square feet) and the coatings on the interior of the elevator enclosure (2,700 square feet). These areas were placed in the CEL. The bulk of the concrete coatings in the Containment Building either had satisfactory DFTs on the first backfit inspection or were repaired until they passed the DFT test.

(4) Miscellaneous Steel Test Results

(a) Adhesion Testing. As stated in 4.b(1), TUEC provided RIV with the results of 4,714 adhesion tests on miscellaneous steel coatings (2,189 PCRs recording 1 to 3 adhesion tests on each) in a package transmitted by letter, dated July 16, 1984. TUEC stated that the 4,714 adhesion tests represented approximately 22 percent of the coated miscellaneous steel surfaces in the Containment Building. The miscellaneous steel category includes items such as pipe supports, cable tray supports, and conduit supports. The surfaces not subjected to the backfit inspection were: (1) those not coated at the time of backfit inspection; (2) those inaccessible to test equipment; and, (3) those not inspected due to termination of the test program on February 10, 1984.

The TUEC letter of July 16, 1984, indicated 26 failures out of the 4,714 adhesion test readings, giving a test failure rate of 0.55 percent. TUEC did not provide an analysis of the adhesion

test data on miscellaneous steel after correcting for Elcometer calibration error.

The TRT did not conduct a complete independent analysis of the massive amount of adhesion data for miscellaneous steel. The data recorded on a randomly selected group of 42 PCRs, encompassing 78 adhesion tests, were analyzed in detail. The surface areas of 22 of these items were recorded as less than 10 square feet, on which only one adhesion test was usually made. The TRT observed that, after correction for calibration error, 15 adhesion test readings were below 200 psi, giving a test failure rate of approximately 19 percent for the 78 adhesion tests. Because of the large variation and uncertainty in the area represented by each adhesion test for miscellaneous steel items, the TRT did not attempt to determine a failure rate in terms of area from the available data.

The TRT failure rate was so much larger than the rate reported by TUEC (0.55%) due to the effect of correcting for calibration error. Only 1 of the 15 failed readings observed by the TRT was less than 200 psi before correction for calibration error, resulting in an uncorrected failure rate in fair agreement with TUEC's uncorrected rate.

The 42 PCRs chosen by the TRT for detailed audit represented a small fraction of the total of 2,189 PCRs on miscellaneous steel. It is, therefore, quite possible that the selected group was not representative of the total population of miscellaneous steel items. However, the TRT's uncorrected failure rate did approximately agree with TUEC's uncorrected rate for the total population. In the July 16, 1984, package of backfit data provided by TUEC, the total area of miscellaneous steel was given as 180,080 square feet. On the basis of the corrected 19 percent failure rate obtained by the TRT, the failed area of miscellaneous steel could be approximately 35,000 square feet, assuming the TRT sample is a representative sample.

(b) Dry Film Thickness (DFT) Testing. A TUEC analysis of the DFT results on miscellaneous steel was reported in correspondence, dated April 17, 1984, from L. Bielfeldt, TUEC to L. R. Abramson, NRC. The allowable thicknesses for coatings on steel are given in 4.b.(2), above. The TUEC analysis indicated that out of a total of 1,517 readings, 129 DFTs were outside the acceptable range, giving a test failure rate of 8.5 percent.

The TRT did not attempt to conduct a complete independent analysis of the massive amount of DFT data for the miscellaneous steel category. The set of 42 PCRs examined for coating adherence was selected to audit the DFT data as well. The TRT observed that out of a total of 252 readings, 39 DFTs were outside the allowable range, giving a failure rate of 15.5 percent. Nine of the failed readings exceeded the allowable DFT; the remaining 30 were too low.

According to TRT interviews with TUEC quality assurance personnel, most of the miscellaneous steel surfaces were reworked with additional topcoat, partly for cosmetic reasons, so that the final DFT failure rate was lower than reported above. The TRT conducted a random sampling of IRs and travelers which confirmed this.

(c) Brookhaven National Laboratory (BNL) Adhesion Test Results. As discussed in section 4a, BNL and its consultant, under contract to Region IV of the NRC, performed some adhesion tests on randomly selected areas of the Containment Building liner, the concrete surfaces, and the miscellaneous steel surfaces. Only ten adhesion tests were made on each of the three surface types, although it was recognized that such a small sample would have limited statistical significance.

As reported in BNL's interim report to NRC Region IV, dated April 25, 1984, four out of the ten adhesion tests for the liner plate failed the 200-psi acceptance value with corrected readings of 156, 186, 186 and 186 psi. No failures were observed in the ten tests for the miscellaneous steel coatings. One of the ten tests failed for the concrete surfaces; however, this failure was in the concrete substrate, not in the protective coating.

Comparing these results with those reported by TUEC and with the TRT audit of TUEC's results, the BNL results are consistent with the corrected TUEC data for the concrete surfaces and for the miscellaneous steel coatings, considering the small size of the BNL sample. However, the 40 percent failure rate on the Containment Building liner coatings observed by BNL was much higher than the failure rate of approximately 5 percent based on corrected TUEC adhesion test data.

In a letter dated July 20, 1984, TUEC stated that three of the four failed liner tests sampled an area under the equipment hatch (elevation 812 feet, azimuth 225°) which had not been painted until after the backfit program had been terminated. The TUEC letter stated that further adhesion testing showed that the failed area was extremely isolated and had been repaired.

The TRT examined inspection records, including maps, pertaining to the additional adhesion testing and repair in the liner area under the equipment hatch (PCR1-0031601 and traveler UI-006720), and confirmed that the area failing the adhesion test was limited to a few square feet. In interviews with TUEC QA personnel, the TRT learned that the equipment hatch area was one of three small liner areas in Unit 1 that was coated after the backfit program was terminated. At this time, only a nickel test was used to determine when the primer coat was sufficiently cured to permit topcoating. (See Coatings Category 4, AQO-44, for a discussion of nickel test problems.) Also, during the BNL adhesion testing, BNL and TUEC QA personnel detected a solvent odor on the test dollies after they were pulled off the coated surface. This suggested a primer curing problem, which may have accounted for the high failure rate in the equipment hatch area.

Only one of the five adhesion tests of the liner at the 945-foot elevation failed. The TRT found from inspection records and a map of the additional TUEC adhesion testing (PCR1-0031602) that the failed area comprised only a few square feet and that adhesion tests within a foot or two on all sides gave readings above 200 psi.

The TRT concluded that the high adhesion test failure rate observed by BNL for the containment liner represented a very limited area which was probably topcoated before the primer coat had cured. Therefore, the liner failure rate of approximately 5 percent, based on the corrected TUEC data on 869 adhesion tests, was more representative of the condition of the liner coatings as a whole.

(d) Assessment of Individual Allegations. The TRT investigated specific allegations related directly or indirectly to the backfit test program. The TRT assessment of these allegations is discussed in the following paragraphs.

(1) Visual Defects (AQO-18). It is alleged that QC inspectors are not allowed to identify visual defects, such as cracking or blistering, during backfit inspections.

TUEC stated in its June 22, 1984 response to the NRC that "It was not intended that visual inspections of coated surfaces be performed as part of the backfit inspection program," which is incorrect. NCR C-81-01567, Rev. 1 (dated November 22, 1981), NCR C-81-01373, Rev. 2 (dated November 3, 1981), and NCR C-81-01613, Rev. 1 (dated February 5, 1982), are generic NCRs covering the BTP, and require visual inspections as part of the NCR disposition. Instruction QI-QP-11.4-23, Rev. 2 (dated December 17, 1981), required a visual inspection; Rev. 3, deletes this requirement. Similarly, Instruction QI-QA-11.4-24, Rev. 0 (dated February 5, 1982), required a visual inspection which was deleted in Rev. 1.

The TUEC June 22, 1984, response also stated that visual inspections are part of the finish-coat final acceptance inspections in procedures QI-QP-11.4-5 and QI-QP-11.4-10. The TRT reviewed procedure QI-QP-11.4-5, Rev. 5 (dated November 18, 1981) through Rev. 27 (dated November 18, 1983) and Procedure QI-QP-11.4-10, Rev. 2 (dated November 11, 1981) through Rev. 18 (dated January 16, 1984). Both of these procedures have steps for visual inspections included in the inspection report (IR).

The TRT found that, although visual defects were not recorded as part of the backfit inspection, they were recorded using IRs and other procedures. TRT concerns about procedures QI-QP-11.4-5 and QI-QP-11.4-10 and visual inspections are discussed further in the TRT's procedures review. (See Coatings Category 4 in this Appendix.)

(2) Backfit Program Vague (AQO-19). It is alleged that Instructions QI-QP-11.4-23 and QI-QP-11.4-24 are very vague regarding the way the backfit inspections are to be conducted. A detailed evaluation of these procedures is found in Coatings Category 4, under the discussion of AQO-19, which is summarized below.

The TRT reviewed both QI-QP-11.4-23 (through Rev. 12, dated October 24, 1983) and QI-QP-11.4-24 (through Rev. 6, dated July 14, 1983). It was the TRT's opinion that these procedures could be interpreted properly by a well trained QC Inspector, but that a QC Inspector who was not well trained in these procedures could have difficulty implementing them correctly. The TRT had additional concerns about TUEC coating procedures and inspector training. (These concerns are discussed in Coatings Categories 4 and 7.)

(3) Improper Adhesion Testing (AQO-20). It is alleged that adhesion testing of the protective coatings is not performed properly. It is also alleged that QC Inspectors are instructed not to cut around the adhesion test dollies when conducting adhesion tests contrary to the instructions provided by the manufacturer of the adhesion tester. (The manufacturer's instructions are referenced by CPSES Specification AS-31.)

In the June 22, 1984, response to the NRC, TUEC stated that they did not follow the manufacturer's instructions that came with the instrument. The TRT determined that the allegation, as characterized above, was substantially correct. QC Inspectors did not scribe around dollies, although the manufacturer instructs the user to score around the dollies prior to performing the tests. TUEC provided results of onsite testing to support the position that scribing or not scribing does not affect test results. The TRT reviewed these test results, as well as information from other qualified individuals in the industry, and determined that the failure to scribe around dollies did not affect test results and was not a technically improper procedure. The TRT noted that TUEC has since modified site practice to institute scoring around dollies in compliance with the manufacturer's instructions. (This allegation is also discussed under Coatings Category 4.)

(4) Adhesion Tester Calibration Correction (AQO-21). It is alleged that Brown & Root is doing the calibration on these adhesion testers and that they are not using a corrected value curve (which should have been supplied with each unit) after each calibration.

As alleged, TUEC did not correct adhesion test readings for Elcometer calibration error until after the backfit inspection program was terminated. The effect of making these corrections on adhesion test failure rates is discussed in detail in 4.b(1), above.

(5) Backfit Records (AQO-37). It is alleged that:

(a) in the backfit test program, areas that were documented as having satisfactory primer actually had 10 mils of primer, which exceeded the allowed maximum;

(b) none of the maps documenting areas of adequate primer are correct;

(c) documentation for the backfit test program was forged and falsified;

(d) a QC inspector on the night shift wrote up acceptable IRs for the Containment Building dome area without ever performing those inspections; several QC inspectors would "buy off" anything; and, on several occasions at least one QC inspector conducted his coatings inspections from several floors below where the paint was being applied.

"Satisfactory" primer exceeded the allowed maximum. The TRT discussed this issue with TUEC management, and with Quality Engineering and Quality Control inspectors. All parties contacted indicated that it was true that, in some cases, during backfit inspections performed on steel liner, spot DFT readings for primer coated surfaces with acceptable documentation were found to be outside of the acceptable DFT range of the primer and were documented as unsatisfactory. In its June 22, 1984, letter to NRC, TUEC stated that unsatisfactory readings detected during the backfit test program were tracked by IRs until the conditions were corrected. The examination of backfit IR records indicated that unsatisfactory conditions were noted and a new IR was generated after the item was corrected. A random sampling of IRs by the TRT confirmed this. The TRT determined that an alternate disposition was to prepare a design change authorization (DCA) that widened the range for the DFT readings. (TRT concerns with these DCAs and their effect on DBA qualification of coatings are discussed in Coating Category 2.)

Allegations AQO-54 and -55, which are closely related to this subject are assessed individually below.

Backfit liner maps incorrect. The TRT initially examined the liner plate maps used to keep track of backfit testing and rework. These maps indicated areas that had primer applied, inaccessible areas, and uncoated liner plate. These areas were clearly indicated by bold, dark border lines with the backfit inspection report (PCR) numbers, azimuths, and elevations identified in the center. There were no apparent discrepancies noted when reviewing the maps and associated PCRs. The only discrepancy that could have occurred was that incorrect azimuths were given by the

QC inspectors. The TRT discussed this issue with QC inspectors who were familiar with the mapping system. The QC inspectors stated that there were no azimuth markings on the liner which QC could use to obtain precise measurements for location; therefore, QC inspectors used approximate locations. This practice would cause a gap or overlap between adjacent inspected areas when laid out on maps, even though there was full coverage of inspection performed on the liner by QC.

The TRT reviewed the final liner plate map which outlined all liner areas that were backfit tested. As stated in 4.b(2) above, the TRT reviewed the data in 869 liner plate PCRs, compared their indicated locations with the final map, and did not find any serious discrepancies. This map showed that 96 percent of the liner plate area had been backfit tested.

Backfit test program documentation was forged or falsified. This allegation was investigated by the NRC Office of Investigation (OI) for possible wrongdoing.

The TRT reviewed the technical adequacy of the coating records and observed that there were photocopies of paint-batch mix sheets attached to separate coating application inspection checklists for different items which appeared to be coated at the same time and in the same environment. In each exhibit, there was some common identifier, such as Containment Building liner location or item description, that appeared to connect the two documents. The use of photocopied paint-mix sheets was not a violation of procedure, and the TRT did not observe any technical inconsistencies in the exhibit inspection reports. The TRT followed up the review of these exihibits by reviewing three additional folders which contained approximately 250 inspection reports that were randomly selected from the site QA record vaults. Of this sample, the TRT found two inspection reports for which the coating mix date and application date were inconsistent. These two reports applied to the Containment Building liner and referred to NCR C-81-01567, which dispositions such items to be backfit inspected.

Based on its review, the TRT could draw no conclusion as to falsification or forging of records. In addition, the two instances of technical inconsistencies which were found applied to the Containment Building liner, 96 percent of which was backfit inspected. Consequently, the TRT believes that the coated area associated with technically inconsistent records is very small.

A QC Inspector wrote up acceptable IRs without physically inspecting the work. Also, several QC inspectors would "buy off" anything. The TRT group leader contacted the

alleger (A-31) by telephone on September 10, 1984, to obtain further details to aid in investigating this allegation. The alleger reiterated the names of the two inspectors that he had provided to NRC Region IV OI in October 1983, and which were included in OI Report 84-006, dated March 7, 1984. However, the alleger was not able to identify specific plant locations involved or specific IR numbers or dates.

The TRT then reviewed approximately two dozen IRs prepared by one of the inspectors named, and approximately a dozen IRs prepared by the other inspector named. The TRT could not determine from these records that the inspections were not actually performed.

The TRT did not attempt further investigation of this allegation and considered it to be indeterminate with respect to technical significance. In addition, the TRT did not investigate further with respect to possible wrongdoing, which is beyond the scope of the TRT's responsibilities.

(6) Rust Seen Through Tooke Gauge Tests (AQO-46).

(a) It is alleged that, during Tooke gauge tests, rust was seen on steel substrate and grease, grime, filth, and other contaminants were observed on concrete substrate.

(b) It is alleged that Elcometer adhesion dollies, after being pulled off a coated surface, had rust adhering to the underside. It is also alleged that the QC Lead Inspector was aware of this condition and failed to take any corrective action.

The TRT review of part (a) of this allegation indicated that it was not realistic for anyone to observe rust, grease, grime, filth, or other contaminants under 5 to 6 mils of primer and finish coat through a Tooke DFT gauge. An experiment conducted by the TRT and a TUEC representative with a primer coat of Dimecote 6 on steel substrate illustrated that Dimecote 6 could have possibly been mistaken as a light shade of rust, as it has a light, reddish-gray color. A QC inspector without a great deal of experience with Dimecote 6 could mistake the reddish pigmentation for rust. The TRT found no IRs or NCRs that document this allegation. Coatings Category 7, "Training," assesses allegation AQO-33, which was raised by another alleger and which relates to coating failure due to rust on the seal table A-frame steel. However, the A-frame rust was not established by a Tooke DFT gauge.

The TRT review of part (b) of this allegation consisted of interviewing six QC inspectors certified for backfit test program inspections. Each of the inspectors stated that he had seen or heard of reports of adhesion tests which revealed surface rusting. However, no specific locations were indicated.

The inspectors stated their belief that, in each instance, the affected area was identified and repaired in accordance with procedural requirements. The TRT made no attempt to verify such repairs, since specific locations were not known. The significance of this allegation, to the extent that it is substantiated, is best judged by the backfit adhesion test results presented in Section 4.b, above.

(7) Adhesion Tests Performed in Violation of Written Instructions (AQO-47). It is alleged that, in violation of a written instructions, QC inspectors were instructed to perform approximately 25 Elcometer adhesion tests for an installation hanger for the steam generators.

When a protective coating on steel fails an adhesion test, TUEC procedure QI-QP-11.4-5 requires additional adhesion tests in the vicinity of the failed test to delineate the extent of unsatisfactory coating which must be repaired. Contrary to the allegation, the written instruction does not place an upper limit on the number of adhesion tests required to determine the extent of unsatisfactory coating.

In response to this allegation, TUEC by letter from L. F. Fikar to NRC RIV, dated June 22, 1984, described a case where construction personnel requested QC inspectors to perform a total of 32 adhesion tests on the insulation support ring of steam generator No. 4 after failures were observed in the first two of three sets of adhesion tests. In this case, there were two failures in the last 26 adhesion tests, and the entire ring was stripped and recoated. It would have been a violation of Instruction QI-QP-11.4-5 if areas which failed the adhesion test had not been reworked. In the absence of evidence that requests for additional pull tests were used to avoid reworking areas of unsatisfactory coatings, the TRT found this allegation to be unsubstantiated.

(8) During the Backfit Test Program, Only the First Unsatisfactory DFT Reading was Recorded (AQO-54). It is alleged that during the backfit test program, only the first unsatisfactory reading was recorded, even if the following readings were either higher or lower, i.e., further out of the acceptable range. It is also alleged that the trend analysis was adversely affected because the actual readings were not included.

The alleger's main concern appeared to be that if the first unsatisfactory reading of coating thickness was only slightly out of specification, and this was the only unsatisfactory reading recorded for the sampled area, then the true thickness range for that area would not be known. If the range of acceptable thicknesses was later widened by a DCA to include the recorded reading, then the sampled area would be dispositioned as satisfactory even though other unrecorded thickness readings might have been outside the widened thickness specifications. Consequently, such an area would neither be repaired nor entered into the CEL.

The specification changes widening the acceptable range of coating

thicknesses on steel and concrete are discussed in Section 4.b above, in the TRT's assessment of allegation AQO-55 below, and in Coatings Category 2, "DBA Qualification Testing." The TRT was not able to ascertain independently the extent to which inspectors recorded only the first unsatisfactory thickness reading of coatings. However, the alleger stated that the problem was not widespread and that inspectors generally did not follow the verbal instruction of a particular QC supervisor to record only the first unsatisfactory reading unless the supervisor was watching.

Other factors tending to mitigate the practical effect of the first-reading-only practice are the following.

(1) Most of the out-of-specification thickness readings were too low. For the coatings used on steel at CPSES, adhesion is more strongly affected by primer or topcoat which is too thick. For the coatings which were used on concrete, the specified thickness range was much greater so that slight variations in the extent to which thickness was out-of-specification have a lesser effect.

(2) Approximately 96 percent of the Containment Building liner and 50 percent of the concrete surfaces in Unit 1 were backfit-inspected for coating thickness. Except for a few areas of limited size, which were included in the CEL, all nonconforming areas of the liner and concrete were reworked until the coating thicknesses were in the allowable range. Only 22 percent of the miscellaneous steel coatings were backfit-inspected; the miscellaneous steel items with nonconforming primer or topcoat thicknesses were entered into the CEL by NCR-C-83-01305 instead of being repaired.

(3) According to TUEC QA personnel interviewed by the TRT, a large majority of the 22 percent of the backfit-tested miscellaneous steel items with low topcoat thicknesses were in fact reworked with more topcoat, partly for cosmetic reasons. A random sampling of IRs by the TRT confirmed this. For similar cosmetic reasons, additional topcoat was applied to most of the coatings which had not been backfit-inspected (4 percent of the Containment Building liner, 50 percent of the concrete surfaces, and 78 percent of the miscellaneous steel surfaces).

Because of the three mitigating factors and the alleger's statement that inspectors followed the first-reading-only practice only when under the supervisor's scrutiny, the TRT concludes that the practice would adversely affect the quality of only a small fraction of the protective coatings.

To look into possible wrongdoing relative to the verbal instructions given by the QC supervisor as indicated above, the TRT Project Director forwarded the transcribed NRC interview with the alleger to NRC Region IV OI for its review in a letter dated August 24, 1984.

(9) <u>Areas Identified During the Backfit Test Program as Requiring Coatings Removal did not Have Coatings Removed (AQO-55)</u>. It is alleged that

areas identified during the backfit test program as being outside of the acceptable thickness range for applied coatings were not reworked as required.

As discussed above in 4.b, the ranges of acceptable coating thicknesses were widened by DCAs (e.g. DCA 12,145). The widened ranges were incorporated into the later revisions of procedures QI-QP-11.4-23 and QI-WP-11.4-24. After these revisions, some coatings which met the expanded specifications were dispositioned "use as is," whereas repair would have been required by the earlier specifications.

The TRT evaluation of allegation AQO-54 stated that NCR-C-83-01305 permitted miscellaneous steel items with nonconforming primer or total coating thickness to be placed in the CEL rather than being repaired. TUEC procedures and NCRs required the repair of nonconforming coating thicknesses on Containment Building liner and concrete surfaces. In its review of inspection reports and NCRs related to protective coatings, the TRT found no instances where unsatisfactory coatings were dispositioned "use as is" without being entered into the CEL. However, according to interviews with TUEC QA personnel, the entry of miscellaneous steel items into the CEL (the first four entries in the CEL) was based on a TUEC assumption that 5 percent of each category of miscellaneous steel was of indeterminate quality. As discussed in Section 4.b and in Coatings Category 6, "Coating Exempt Log," this assumption may be low.

The uncertainty regarding the miscellaneous steel CEL entries may be considered to be a partial substantiation of the allegation. The TRT found no other evidence confirming this allegation.

(10) BTP Documentation Destroyed (AQO-56). It is alleged that original documentation related to the backfit test program was destroyed by QA management.

This allegation involves possible wrongdoing and is outside the TRT's assigned scope; therefore the TRT did not directly investigate this allegation. In addition, since the alleger could not identify which documents were destroyed, the TRT was unable to make any cross-check from related documents to substantiate the allegation, nor could the TRT make any technical assessment of the impact of the alleged destroyed documents on the quality of coatings. The alleger indirectly relates this allegation to forging and falsification of BTP documents (alleged by another person) which was assessed in allegation AQO-37(c).

In a letter dated August 24, 1984, the TRT director forwarded the transcribed NRC interview with this alleger to NRC Region IV OI for its review.

5. Conclusions and Staff Position:

a. Specific Allegations Concerning BTP. The TRT's conclusions concerning specific allegations related directly or indirectly to the coatings backfit test program (BTP) are as follows:

(1) Allegations AQO-18, -20, and -37(a) were substantiated; however, for the reasons stated in the corresponding assessments, the TRT does not consider them to be of significant technical concern in regard to the BTP.

Allegation AQO-21 was also substantiated. As discussed in detail in 4(b), the TRT concludes that correcting adhesion test results for Elcometer calibration error has only a small effect on liner and concrete test failure rates, but could significantly change the test failure rate for miscellaneous steel. For the liner plate, the failure rate changed only from TUEC's uncorrected 2.3 percent (20/869) to the TRT's corrected rate of 4.3 percent (36/834) or to TUEC's corrected rate of 5.9 percent (51/869). For the concrete, the change was from a 0 percent uncorrected failure rate to the TRT's corrected 6.8-percent (8/116) rate or to TUEC's corrected rate of 3.1 percent (65/2128). For miscellaneous steel, however, the test failure rate could change from less than 1 percent (26/4714), uncorrected, to as much as 19 percent corrected, based on a limited sample analysis by the TRT.

(2) Allegations AQO-37(c), -54, and -55 were partially substantiated. The TRT could not draw a conclusion as to forging or falsification of documents for allegation AQO-37(c), but did find two instances of technically inconsistent inspection documents which may involve only a small area of liner coating. The TRT does not consider allegations AQO-54 and -55 to have any significant effect since the TRT believes that the area which was not reworked due to coating thickness out of tolerance is small. However, TUEC's estimated 5 percent miscellaneous steel coating area allowance due to indeterminate quality may be low.

(3) The TRT concludes that allegations AQO-19, -37(b), -46(a), -46(b), and 47 were not substantiated, and therefore are of no concern.

(4) The TRT concludes that allegation AQO-37(d) was indeterminate with respect to technical significance. The TRT did not investigate possible wrongdoing in regard to this allegation.

(5) The TRT did not investigate allegation AQO-56 since it involves wrongdoing and there was insufficient information available to assess its potential extent and effect on coating quality. This allegation has been referred to NRC Region IV OI for review.

Even though the TRT found that most of the allegations were of small technical significance with respect to the BTP overall pass/fail rate, many of them, as indicated in the individual assessments, relate directly to TRT generic concerns about other aspects of the TUEC coating QA program and are addressed in other Coatings categories.

b. Evaluation of Backfit Program Test Results. The TRT evaluated the BTP inspection and test field data to determine independently, within practical limits, the extent of the coated areas tested by TUEC and the extent to which tested coatings passed their DFT and adhesion test acceptance criteria.

It is the TRT's opinion that if DBA-qualified coating was applied and its traceability was maintained, then the BTP, properly administered, could provide useful, but indirect information on the quality and DBA survivability of the coating work. However, the TRT found serious shortcomings in DBA qualification and traceability of coatings as discussed in Coatings Categories 2 and 3, respectively. Further, the TRT does not consider that the BTP scope or results provide information that resolves these shortcomings. Nevertheless, the TRT concludes that the thousands of tests conducted under the BTP provide a useful overall measure of two important coating quality parameters: adhesion strength and coating thickness.

The results of the BTP adhesion tests, corrected for Elcometer calibration error, are summarized in the following table. On the basis of these results, reasonably accurate estimates of the adhesion test failure rate and the corresponding failed areas can be made for the coatings on the Containment Building liner and concrete surfaces. For the miscellaneous steel surfaces, the adhesion test failure rate could be only crudely approximated, because corrected adhesion test data are lacking except for the small sample audited by the TRT. The TRT's corrected data failure rate is approximately 19 percent, in contrast to TUEC's uncorrected data failure rate of less than 1 percent. A 19-percent miscellaneous steel failure rate corresponds to a failed coating area of 34,200 square feet. As shown in the table, this figure, in addition to the failed areas of the Containment Building liner and the concrete, gives a total of approximately 57,500 square feet of coatings which failed adhesion tests. Currently, less than 3000 square feet are entered into the CEL for this reason. (See Coatings Category 6.)

In addition to the adhesion tests, the other BTP test performed was for coating thickness measurement. For the liner and concrete, coatings with thicknesses outside of the allowable range were reworked until the thicknesses were acceptable (although the allowable range was expanded several times) in nearly all cases. In the low percentage of cases, where repair was not feasible, the discrepant areas were placed in the CEL.

For miscellaneous steel with unsatisfactory coating thicknesses, the item could be dispositioned "use-as-is" and placed in the CEL by NCRs, e.g., NCR C-83-03103. Rather than attempt to estimate the area of each discrepant item, TUEC conservatively entered approximately 5 percent of each type of miscellaneous steel area totalling 8150 square feet in the CEL. The 5 percent entry may be low because the DFT test failure rate was 8.5 percent cosmetic rework.

In summary, based on its review of BTP data, the TRT estimates that 90 percent of all coated surfaces meet adhesion test requirements (assuming a 19 percent failure rate for miscellaneous steel). The TRT estimates that more than 90 percent of the coated surface thickness was acceptable (allowing for repeated relaxation in thickness tolerances). However, the extent to which the BTP demonstrated

ADHESION TEST DATA

Item	Total Area ft^2	TRT ESTIMATE			TUEC ESTIMATE		
		% Area Audited	Failure Rate, %	Failed Area, ft^2	% Area Tested	Failure Rate, %	Est. Failed Area, ft^2
Containment Liner	110,000	79%	3.6%	3960	96%	5.9%	6490
Concrete	285,000	3.9%	6.8%	19400	50%	3.1%	8835
Miscellaneous Steel	180,000	0.36%	19%	34200	22%	Not Available	Not Available
Total	575,000			57560			

that FSAR coating quality requirements were met is dependent on resolution of other TRT generic concerns related to DBA qualification and traceability of coatings, as discussed in Coating Categories 2 and 3. These deficiencies, although not of safety significance in the coatings area, must be considered in evaluating the effectiveness of TUEC's overall QA/QC program.

For an integrated assessment of the estimated total coating area inside the Containment Building which failed the BTP and/or had indeterminate quality for other reasons, including vendor equipment with unqualified coatings, refer to Coatings Category 6, "Coating Exempt Log."

Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. A summary of the followup interviews is included in Section 2.2.3 of this Appendix.

6. Action Required: The TRT reviewed the procedures used and the inspection reports (PCRs) and statistical data which resulted from the Coatings Backfit Test Program conducted for coatings applied to the Containment Building liner, concrete structures, and miscellaneous steel.

For the 2189 miscellaneous steel items (such as pipe hangers, cable trays, equipment, and conduit supports) that were tested under the backfit test program from about December 1981 to February 1984, the TRT found that TUEC did not correct any of the coating adhesion test field data to account for the calibration error of the Elcometers used for the tests. Consequently, the field test data could be in error by as much as 200 psi in a nonconservative direction. Thus, any Elcometer reading less than 400 psi potentially represents a test that failed to meet the test acceptance criterion of 200 psi.

Based on TRT analysis of sampled data covering 78 test results for 42 miscellaneous steel items, the appropriate calibration correction could increase the adhesion test failure rate from about 1 percent to 19 percent. The following inspection reports (PCRs) indicate acceptable test results ($\geq$200 psi) before correction, but unacceptable test results (<200 psi) after correction:

PCR-02103	PCR-02164
PCR-02105	PCR-02166
PCR-02515	PCR-02171

Accordingly, TUEC shall:

(1) Apply the Elcometer calibration correction to the data for the 4714 adhesion tests covering 2189 miscellaneous steel items tested to establish a more reliable estimate of the adhesion test failure rate. This revised analysis should include a statistical analysis showing the 95 percent confidence upper limit of the failure rate for all the miscellaneous steel items inside the Containment Building.

(2) Analyze the corrected data to establish a more reliable estimate of the fraction of tested miscellaneous steel coated surface that failed the adhesion test acceptance criterion. The resulting failed areas shall be entered in the Protective Coating Exempt Log. (See Coatings Category 6.) The coatings exempt log will be used in planning future inspections of coatings consistent with the guidelines of Appendix L.

1. Allegation Category: Coatings 2, Design Basis Accident (DBA) Qualification Testing

2. Allegation Number: Parts of AQO-01, AQO-02, AQO-03, AQO-04, AQO-05, AQO-06, AQO-09, AQO-10, AQO-11, AQO-12, AQO-13, and AQO-15

3. Characterization: It is alleged that some protective coating systems applied at the Comanche Peak Steam Electric Station (CPSES) are not DBA qualified. Examples are:

   - B&R Procedure CCP-40, Paragraph 4.3.1.2, allows the application of Imperial coatings (Southern Imperial Coatings of New Orleans) in the sequential order 11S/1201/11S/1201 or 11S/1201/11/1201. The alleger questions whether adequate testing has been performed to demonstrate the DBA qualifications of these materials applied in these sequences (AQO-01).

   - Nonconformance report (NCR) C83-01752, June 23, 1983, indicates that repair coating systems can be applied in sequences different from the original application sequences. The alleger questions whether adequate testing has been performed to demonstrate the DBA qualification of materials applied in these different sequences (AQO-02).

   - Design change authorization (DCA) 17,142, Revision 2, permits Carboline Phenoline 305 (P-305) to be applied over another manufacturer's epoxy coating. The alleger questions whether this combination of different manufacturers' coatings has been DBA tested (AQO-03).

   - DCA 12,374, Revision 1, permits Carboline Carbo Zinc 11 (CZ-11) to be topcoated with Imperial 1201. The alleger questions whether this combination of different manufacturers' coatings has been DBA tested (AQO-04).

   - CPSES Procedure CCP-30A, Revision 2, Paragraph 1.3.1, allows P-305 to be applied over Ameron Dimecote 6 (D-6). The alleger questions whether this combination of different manufacturers' coating materials has been DBA qualification tested (AQO-05).

   - CPSES Procedure CCP-40, Revision 5, Paragraph 4.1.1.3, permits Imperial Nutec 11S surfacer to be applied over foreign objects embedded in concrete. The alleger questions whether adequate testing has been performed to demonstrate the DBA qualifications of this material applied over foreign objects (AQO-06).

   - It is alleged that inorganic zinc primer has been applied in three coats and that this three-coat application method has not been DBA qualification tested (AQO-09).

   - It is alleged that coatings applied to surfaces which were prepared by power tool cleaning were smoothed or polished, and thus do not have adequate surface profile. The alleger questions whether adequate testing has been performed to demonstrate the DBA qualifications of materials applied to such smoothed or polished surfaces (AQO-10).

- It is alleged that DCA 18,489, allows the application of primer at a thickness of 0.5 mils. The alleger questions whether DBA testing has been performed for primer this thin (AQO-11).

- CPSES Procedure CCP-40, Revision 5, Paragraph 4.3.1.2, allows application of the Imperial coating system at a thickness of 102 mils. The alleger questions whether this system has been DBA qualification tested for coatings this thick (AQO-12).

- It is alleged that adequate testing has not been performed to demonstrate the DBA qualifications of coatings applied in the reactor core cavity where they will be subjected to higher levels of neutron and gamma exposure than coatings in other areas (AQO-13).

- CPSES Procedure CCP-30, Revision 11, Paragraph 4.4.3.0, allows the application of CZ-11 or Carboline 191 primer (191P) over P-305, and the application of P-305 over Imperial 1201. The alleger questions whether adequate testing has been performed to demonstrate the DBA qualifications of these materials applied in these non-standard combinations and sequences (AQO-15).

4. Assessment of Safety Significance: The majority of allegations in this category address both DBA qualifications and procedures which may have permitted the application of non-DBA qualified coatings. The procedural aspects of these allegations are addressed in Category 4.

Review of DBA Qualification Test Data

In assessing these allegations, the NRC Technical Review Team (TRT) reviewed the requirements pertaining to DBA testing of protective coating materials used inside primary containment structures at CPSES. The CPSES FSAR, Section 6.1.2, and Technical Specification AS-31 commit Texas Utilities Electric Company (TUEC) to compliance with American National Standards Institute (ANSI) standards N101.2 and N512, which provide the methods and criteria for DBA testing. This testing must be performed under temperature, pressure, and irradiation conditions which simulate both normal plant operating conditions and loss of coolant accident (LOCA), i.e., DBA, conditions. These standards specify that the coating systems tested must be the same as those actually used in the plant in terms of surface preparation, coating materials, application methods and conditions, and coating thickness.

CPSES Specification 2323 AS-31, which governs safety-related coating work, requires that the DBA testing be performed by both the coating manufacturers and Oak Ridge National Laboratories (ORNL). The CPSES FSAR, Section 6.1.2, also commits TUEC to compliance with ANSI N45.2.11, which provides requirements for design activities, including evaluation of design input information (such as DBA tests), both for the initial design and all changes thereto, and for records which must be maintained to document design activities.

The TRT investigated compliance with these requirements at CPSES, concentrating on the coating systems which were used for the major surface

areas inside the Containment Building. Secondary consideration was given by the TRT to the many different "coating systems" that were used in certain small areas, such as overlaps between different systems, repairs, and other special cases, including those described in the allegations.

The TRT investigation of the DBA concerns included interviews with approximately 12 individuals involved in design and engineering relative to coatings at CPSES. Those interviewed were from Gibbs & Hill, ORNL, Texas Utilities Service, Inc. (TUSI), TUGCO, EBASCO, and Brown & Root and were involved in design, chemical engineering, DBA testing, field engineering, design changes, design and design change control, records management, and quality assurance. The TRT conducted an in-depth review of numerous DBA and other test reports, of related documents provided by TUEC, of pertinent CPSES site files of DCAs, and of vendor-approval records. The TRT also reviewed relevant American National Standards Institute (ANSI) industry standards, NRC information reports, TUEC licensing documents, TUGCO procedures, and Regulatory Guides.

The TRT requested from TUEC copies of DBA test data and evaluations applicable to CPSES containment structure coatings systems. On August 10, 1984, TUEC provided a package labeled "DBA Reports - Site Civil Engr File," and on August 29, 1984, TUEC provided five packages of DBA data from the CPSES vault. TUEC explained that the five "vault packages" were the official DBA Test Reports which demonstrate the acceptability of the major coating systems at CPSES, and this was confirmed in a September 3, 1984, TUGCO memorandum from the former CPSES QA Manager to the TUGCO Vice President and CPSES Project General Manager, a copy of which TUEC presented to the TRT on September 10, 1984. The TRT reviewed all of the above test reports and found them to be incomplete, inconsistent, and inadequate in demonstrating that the major coating systems used at CPSES had been qualified in accordance with ANSI N512 and N101.2. The TRT verified this finding by performing a second review of only the five official vault packages that yielded the same results. Although the packages contained some pertinent testing data, they also contained a large quantity of information which was not applicable or not valid, and the pertinent data was not adequate to demonstrate that the coatings were qualified.

The TRT found no records to demonstrate that the DBA testing data had been reviewed by CPSES personnel and no records of engineering evaluation of the data by TUEC, either in the test report packages, the vendor file, or elsewhere, as required by ANSI N45.2.11. Information provided to the TRT by TUEC in the September 3, 1984, memorandum indicated that Gibbs & Hill (the CPSES Architect/Engineer) was involved in the design process for coatings, but did not demonstrate that an engineering evaluation of the DBA test data had been performed. The TRT concluded that such a recorded engineering evaluation was necessary, not only because it is required by ANSI N45.2.11, but also because the files of testing data by themselves do not demonstrate the qualifications of the coatings without interpretation and additional data. The TRT observed that the DBA data base files were deficient in that:

(a) There were three different test report data bases, each containing different data: those used by Gibbs & Hill; those used by CPSES field engineering; and those kept in the CPSES vault.

(b) Many of the reported DBA tests did not include all important criteria (temperature, pressure, and irradiation).

(c) Many of the reported DBA tests were not performed by Oak Ridge National Laboratories (ORNL), as required by CPSES specification 2323-AS-31.

(d) Many of the reported tests included coating materials and coating systems not used at CPSES in combination with materials and systems which were used at CPSES. The inclusion of these "foreign" materials in the systems tested invalidates the applicability of this test data to CPSES.

(e) In some of the reported tests, the test samples failed, indicating that these materials and systems were not qualified to the required criteria, yet these reports were included in the qualification test data base without comment.

(f) Many of the test reports did not include sufficient data to identify either the materials or system tested, the test criteria, or the results.

(g) The data bases included instances of two different, incomplete versions of the same report.

(h) The data bases included an instance of two different reports of two different tests of the same system showing different results, i.e., one report documents that the test was passed and a second report documents that the same system failed the test.

(i) The data bases did not include any one complete, acceptable, valid test that corresponded to each major CPSES coating system.

The following two examples illustrate the deficiencies observed in the test data files:

(1) The site field engineering files included Carboline test report SR-149 that recorded an ORNL test report of August 16, 1978, which included temperature and pressure only, for the following system: CZ-11, at 1.7 to 2.9 mils, topcoated with P-305 at 1.5 to 3.8 mils. In the official vault file there was a different version of this same ORNL report of August 16, 1978, which included temperature and pressure only for the following system: CZ-11, at 3 to 4 mils, with a topcoat different from that used at CPSES.

(2) The official vault package included a Carboline Laboratory test report for Testing Project Number 01931, February 10, 1981. The report gave the results of a test performed by Carboline for temperature and pressure criteria only on the following repair system: Carboline 191

primer (191P) at 4.0 to 4.5 mils, topcoated with P-305 at 3.0 to 3.5 mils, over a power-tool-cleaned surface (that had previously been abrasive blasted and coated with the CZ-11/P-305 system). The report indicates that the samples tested passed. The site field engineering package included a report of Carboline Testing Project 01978 which reported a DBA test by ORNL of April 7, 1982, which included temperature, pressure, and irradiation for the same system: power tool cleaning, 191P at 4.5 to 5.25 mils, and P-305 at 3.25 to 4.0 mils. In this report, two of the six samples tested at ORNL failed the test.

As a final check on the validity of the DBA test data, the TRT analyzed the data in the five official vault packages for the major steel coating system at CPSES: abrasive blasting to Steel Structures Painting Council (SSPC) standard SSPC-SP-10 (Near White Metal), CZ-11 primer, and P-305 topcoat. The dry film thickness acceptance criteria for this system at CPSES (as provided by CPSES procedures for coating work) is 1.5 to 7.0 mils for CZ-11 and P-305 thickness adequate to provide "full hiding," but with a total system thickness less than 15.0 mils. The purpose of the TRT analysis was to determine whether these packages included enough valid information to enable an engineering evaluation to be performed to demonstrate that this system, as applied at CPSES, meets the criteria of ANSI N101.2 and N512. For the analysis, the TRT assumed the accuracy of the data in the packages and the technical applicability of the testing performed by the manufacturer, although such testing did not include irradiation. Test data were not considered in this analysis if the test did not include either CZ-11 or P-305, if the sample(s) tested did not meet the ANSI N101.2 and N512 acceptance criteria, or if the test report did not include sufficient detail to identify the particulars (e.g., dry film thickness) of the material(s) tested. The TRT found that: (a) the only item for which there was full ORNL testing data was CZ-11, by itself, at 2.0 to 3.5 mils DFT; (b) there was no irradiation data for P-305 by itself or for the CZ-11/P-305 system; (c) there was no independent (ORNL) testing data for the CZ-11/P-305 system, as a system; and (d) there was no testing data for the CZ-11/P-305 system that included or closely approached the thickness ranges used at CPSES. The TRT concluded that this testing data did not provide adequate information to enable an engineering analysis to be performed which would demonstrate the qualification of this coating system as applied at CPSES.

In light of the deficiencies in the test data files, and particularly because there were instances of different incomplete versions of the same ORNL report and different test results for the same system, the TRT considered whether TUEC had taken any actions in response to NRC IE Information Notice No. 83-60. (This notice reports an incident of falsified DBA test reports by a coatings vendor and recommends that NRC applicants and licensees can avoid such incidents by obtaining coatings test reports directly from independent testing laboratories.) The TRT found that TUEC had received and analyzed this notice and determined that no action by them was appropriate because they did not require their coatings to be tested by an independent laboratory. The TRT found that all testing reports were, in fact, provided to TUEC by the coating manufacturers. Although it is true that the NRC did not require any action by TUEC based on the IE Notice, the TRT disagrees with TUEC's analysis and conclusion that no action was

appropriate, because that conclusion was based on the erroneous statement that TUEC's procedures do not require independent laboratory testing. CPSES Specification AS-31 does, in fact, require DBA testing by an independent laboratory, in this case ORNL, as well as by the coating manufacturer.

The TRT also examined vendor files to determine if they contained evidence of engineering evaluation of DBA test data as part of the vendor approval process. This examination included a review of vendor files for coating manufacturers Ameron, Carboline, and Imperial. These files did contain evidence of a functioning vendor-approval system which included evaluation of vendor QA program manuals, surveillance and audits at the vendors' facilities by TUEC representatives, and inclusion of pertinent quality requirements in purchase orders to the vendors. However, these files did not include evidence that TUEC engineering had evaluated DBA test data.

Review of Design Changes

The TRT next investigated TUEC's design change process to learn whether engineering evaluation of DBA test data was properly used as justification for design changes that affected CPSES coating systems. This investigation included interviews with personnel involved in the design change process, a review of TUSI procedures CP-EP-4.0 and CP-EP-4.6, and an examination of coatings design change records. (The subject of design changes is addressed in further detail in Coatings Category 5c.)

The TRT reviewed all revisions of the major instructions which governed coatings work at CPSES, including Procedures CCP-30, CCP-30A, and CCP-40; selected inspection procedures, including those for backfit inspections; specification 2323-AS-31; and design changes which affected the above. (Further details on procedures and on the backfit program are provided in Coatings Categories 1 and 4.) The TRT found that there were many substantive changes in the coating systems as applied, including changes in allowable thickness criteria, coating materials, sequencing and combinations of materials, surface preparation and coating application methods, and acceptance criteria. All such changes affect the coating system design in that they affect the relationship between the coatings as applied at CPSES and the coatings as DBA tested.

The TRT evaluated design changes affecting coating work which were selected from those identified in allegations and those found by the TRT during its review of TUEC's procedures and instructions for coating work. Eight design changes were chosen because they involved changes for which engineering evaluation and justification would be necessary to demonstrate the DBA qualifications of the resulting coating systems. Design Change Authorizations (DCAs), Change Verification Checklists, and supporting documentation were reviewed for each. In some cases the engineering justification for approval of the change was evident in the documents reviewed, e.g., cases where specification requirements were not met and the coated item in question was placed in the coatings exempt log. However, the majority of the documentation reviewed did not provide any engineering justification or other reason for approval of the change, such as evaluation of new DBA test data. The TRT concluded that records were not adequate to demonstrate

the engineering basis for design changes for coatings at the time those changes were approved.

In response to the TRT's further inquiries, TUEC developed written explanations of the engineering justification for certain design changes and provided them to the TRT in the form of an attachment to the September 3, 1984, memorandum (from the former QA Manager to the TUGCO Vice President and Project General Manager). These explanations reference manufacturer's test reports, ORNL test reports, and accepted industry standards as the basis for the changes. The TRT does not fully agree with the technical validity of these explanations in all cases. For example, in the explanation, they apply a standard which gives a range of allowable deviations from a specified single-point coating thickness, to a pre-specified thickness range. The TRT does not consider this an appropriate application of this standard. Their explanation also cites a report of testing performed by Carboline, which does not include an irradiation test, for various thicknesses of CZ-11 topcoated with 1 mil of P-305, as justification for increasing the thickness of CZ-11 with a much higher thickness of P-305 topcoat. The TRT considers that this test report is not applicable without additional supporting information and evaluation, neither of which were provided.

Review of Individual Allegations

The TRT evaluated the allegations that certain coating systems were not DBA qualified by investigating the DBA qualifications of the various coating systems, which were used for touchup work, overlapping, and other special cases described in the allegations.

Imperial Concrete Coating Sequences (AQO-01). The following sequences of Imperial concrete coatings are permitted by CPSES Procedure CCP-40, Paragraph 4.3.1.2: 11S/1201/11S/1201 and 11S/1201/11/1201. The TRT reviewed CCP-40, Imperial Letter VBR-7697, May 8, 1978, Imperial Technical Report 759, April 19, 1984, Imperial Technical Report 495-81, June 10, 1981, and related correspondence from TUEC to the TRT. CCP-40 permits application in these sequences for repair and touchup work. Imperial Letter VBR-7697 states, "Although the resultant systems 11S/1201/11S/1201 or 11S/1201/11/1201 have not been qualification tested, there is no reason to belicve that they are not viable systems." It is clear that these systems were used and that they were not qualified, a condition which TUEC has acknowledged in correspondence to the TRT.

Imperial Technical Report 759 provides some information to support a finding that these systems are technically viable. This report documents in-house adhesion tests of these systems performed by Imperial, with acceptable results. Imperial Technical Report 495-81 provides ORNL test data that indicates that the individual coating materials in these systems will perform satisfactorily under normal service and DBA conditions. TUEC stated in correspondence to the TRT that these systems were used only in limited areas as needed for overlapping to achieve a smooth application adjacent to previously coated surfaces and repairs. Because of the areas where the overlap was used, TUEC stated that information on the total surface area is not available, and that these areas have not been entered in the coatings exempt log. During examinations of coated concrete surfaces

at CPSES, the TRT did not observe any noticeably thicker areas or ridges in the concrete coatings or any other evidence to refute TUEC's statement that only limited areas of smooth transitions were involved.

The TRT concluded that although these systems are not DBA qualified, their use at CPSES was acceptable.

Repair System Sequences Which Differ From Original Sequences (AQO-02). The TRT reviewed CPSES NCR C83-01752, June 23, 1983, Table A2 in Appendix A of Specification 2323-AS-31, CPSES Procedures CCP-30, Rev. 10, January 26, 1982, CCP-30A, Rev. 2, September 20, 1982, and CCP-40, Rev. 5, August 18, 1982, and related correspondence from TUEC to the TRT.

In NCR C83-01752, the disposition states, "Table A2 in Appendix A of AS31 specifies acceptable coating systems, i.e., primer and final coat, product identification, and vendors . . . . This table does not identify full system sequencing or application parameters." The TRT's review of Table A2 confirmed the accuracy of these statements; however, a note to this table found in Rev. 2, March 15, 1984, of specification AS-31 states, "It is essential that coating systems be used only as specified above, unless an alternate system is proposed by a coating manufacturer and subsequently approved by the engineer."

The concern expressed in this allegation is that repair coatings are applied in different sequences than the original coating system and that these repair sequences are not DBA qualified. The TRT's review of CPSES application procedures CCP-30, CCP-30A, and CCP-40, generally supports TUEC's statement in correspondence to the TRT that repair sequences are not different from original application sequences, except in areas where they overlap. (Coatings Category 4 provides additional information about these procedures and an assessment of their adequacy. The adequacy of DBA test data for the original application sequences, and engineering evaluations of changes to them, are discussed under Review of DBA Qualification Test Data in this assessment.) TUEC stated in correspondence to the TRT that nonstandard sequences occurred only in areas of overlap, that the total area involved is indeterminate but minor, that these areas are not significant enough to warrant special consideration, such as DBA qualification, and that they are not included in the exempt log.

Except as specifically noted elsewhere in this assessment, the TRT concluded that applying coatings in nonstandard sequences that were not specifically DBA qualified was acceptable when used in small areas of repair and overlap.

Applying P-305 Over Another Manufacturer's Epoxy Coating (AQO-03). In assessing this allegation, the TRT reviewed correspondence from TUEC on this subject, TUSI Procedure CP-EP-16.4, Rev. 0, October 31, 1983, "Protective Coatings Exemption Log," selected entries from the Coatings Exempt Log (CEL), and DCA 17,142, Revisions 2 and 3. (Further discussion of the CEL is provided in Coatings Category 6.) The TRT found that although Revision 2 of DCA 17,142 permitted the use of this nonqualified system, Revision 3 provided justification by reference to entry No. 22 in the CEL. The TRT's review of the log found that entry No. 22 recorded

2300 square feet of P-305 applied to the Unit 1 manipulator crane. This area is considered small compared with the approximately 600,000 square feet of coated surface inside the Unit 1 Containment Building. Because entry of an item into the CEL effectively removes it from Service Level I and Specification 2323-AS-31 requirements, the TRT concluded that this item had been handled properly by TUEC and was without adverse consequences.

CZ-11 Topcoated With 1201 (AQO-04). The TRT reviewed DCA 12,374, Rev. 1, November 2, 1982, CEL entry No. 30, Imperial Technical Report #553-81, and related correspondence from TUEC to the TRT. The TRT found that this version of Imperial Technical Report 553-81 (which consisted of extracts from a larger report) gave enough information to provide confidence that the CZ-11/1201 system met DBA qualification requirements. That report, however, does not provide sufficient detail to identify the particulars of the system tested; for example, application methods and conditions and dry film thickness (DFT). The TRT found that DCA 12,374 provides for the coating of Richmond inserts in concrete using this system in accordance with the requirements of CPSES Specification 2323-AS-30, which is the nonsafety-related coatings specification. The DCA does not mention or reference either test report 553-81 or the CEL as justification for this change. The adequacy of the DBA test report data base and of recorded engineering evaluations of design changes is discussed under Review of DBA Qualification Test Data elsewhere in this assessment.

The TRT reviewed the CEL and found that entry No. 30 records 2258 square feet of this system applied to Richmond inserts in the Unit 1 Containment Building. The TRT found that the area estimated was acceptably conservative. (Coatings Category 6 provides additional discussion on the CEL.) Because this item is included in the CEL and involves a relatively small area, the TRT concluded that it is without adverse consequences or safety significance.

P-305 Applied Over D-6 (AQO-05). The TRT reviewed CPSES Procedure CCP-30A, Rev. 2, September 10, 1982, "Coating Steel Substrates Inside Reactor Building and Radiation Areas," Carboline Testing Project 01684, August 11, 1978, and related correspondence from TUEC to the TRT. The TRT found that Procedure CCP-30A is the procedure for application of alternate coating system D-6/P-305 to safety-related steel surfaces. Revision 2 of this procedure provides for a DFT of 1.5 to 5.5 mils for D-6, with total system thickness of 7 to 11.5 mils. TUEC provided the Carboline Testing Project 01684 report to demonstrate the DBA qualification of this system. The TRT reviewed the report and found that it documented a test performed by Carboline for this system, which included temperature and pressure criteria only, for thickness ranges of from 2.4 to 3.5 mils for D-6 and from 7.3 to 11.1 mils for the total system DFT.

The TRT has little technical concern that this system will not perform adequately in service. This is because, in the TRT's opinion, the use of Ameron D-6 with Carboline P-305 is technically acceptable, in that both materials are commonly used nuclear safety-related materials. Ameron D-6 is an inorganic zinc, generically similar to CZ-11, and is commonly used at other nuclear facilities with various Ameron epoxy top coats which are generically similar to P-305. However, the TRT notes that the testing

data provided by TUEC do not demonstrate that this system is qualified, since no irradiation data are included for either material or for the system; other related test data for these materials as used in other systems have not been provided, referenced, or evaluated; and the Carboline test report is not independent and does not include testing over a broad enough range of thicknesses to provide comparability to the thickness range used at CPSES.

11S Applied Over Foreign Objects (AQO-06). This allegation concerns DBA qualification of Imperial Nutec 11S surfacer applied over various foreign objects, such as nails, rebar chairs, bolts, wood, or plastic, embedded in concrete. The TRT reviewed CPSES Procedure No. CCP-40, Revision 5, August 18, 1982, "Protective Coating of Concrete Surfaces," correspondence between Imperial and TUEC, correspondence from TUEC to the TRT, and Imperial Technical Report No. 462-81, January 22, 1982, which was provided with TUEC's correspondence to the TRT.

The TRT found that TUEC had investigated this item to determine the technical consequences of applying NUTEC 11S over embedded objects. The TRT also found that there was no DBA test data to demonstrate the qualification of such applications. The TRT reviewed Imperial Technical Report No. 462-1-81 and noted that it included ORNL testing of NUTEC 11S over steel in which the tested samples did not meet the ANSI N101.2 and N512 acceptance criteria. The fact that, in correspondence to the TRT, TUEC stated that "These tests demonstrate adequate coating performance under DBA conditions" is illustrative of inadequate engineering evaluation by TUEC. Because of the varied locations of embedded objects, TUEC stated that information concerning the total surface area involved was not available, and that these areas were not included in the CEL.

The TRT observed that, except as noted above, TUEC made reasonable efforts to determine the proper treatment of embedded foreign objects and to perform affected coating work in accordance with the coating material manufacturer's recommendation. Because the areas involved were relatively small, the TRT found that although these systems are not DBA qualified, TUEC's treatment of this item was acceptable.

Application of Inorganic Zinc Primer in Three Coats (AQO-09). This allegation is concerned with the application of three coats of inorganic zinc primer at CPSES, which was alleged to be contrary to CPSES Procedure No. QI-QP-11.4.5, Revision 27. It is also alleged that a three-coat system would lack adequate cohesion and is not DBA qualified.

The TRT reviewed Procedure QI-QP-11.4.5, CPSES Procedures CCP-30 and CCP-30A, correspondence from TUEC to the TRT on this subject, and DBA and related test data provided by TUEC, including Carboline Laboratory Test Report No. 01978.1, May 14, 1982, Carboline Testing Project 02182, October 27, 1983, and Ameron Test Report No. TRC-089-03, October 10, 1979. Both the TRT and TUEC noted that the application of three coats of inorganic zinc is not a violation of CPSES procedures. The test reports provided adequate data to demonstrate that application of inorganic zinc in two coats rather than one would have no adverse effect upon material qualification. Furthermore, the TRT determined that excessive DFT due

to multiple coat application was not a problem because overcoating was employed for the specific purpose of bringing thin areas up to the required minimum thickness. Accordingly, no cohesion or compatibility problem is caused by multiple coats of inorganic zinc, provided that proper thinning procedures are followed and that the total dry film thickness is within acceptable limits. The TRT observed that proper thinning practices for overcoating inorganic zinc with inorganic zinc were in effect onsite. This allegation was not substantiated.

Coatings Applied Over Surfaces Cleaned by Power Tools (AQO-10). This allegation concerns the DBA qualifications of repair or touch-up coating work in limited areas in which coatings are applied over surfaces cleaned by power tools. CPSES Procedure QI-QP-11.4-5, Rev. 27, paragraph 3.2.2.3, states: "Surfaces that have been power-tooled with '3-M Clean-N-Strip,' 80-grit or coarser 'flapper wheels,' sanding discs, 'roto peens,' or equivalent provide acceptable surface profile." It is alleged that:

a. The coating systems applied to surfaces prepared using the tools specified above are not DBA qualified.

b. These surface preparation methods provide a smoothing or polishing action, rather than a penetrating action, as obtained with sand-blasting or with a needle gun.

c. The profile that is obtained using these methods occurs in a sparse pattern and not a densely packed pattern.

The TRT reviewed CPSES procedure QI-QP-11.4-5, Rev. 27, and subsequent revisions, ANSI N101.2, and correspondence from TUEC to the TRT, including attached copies of related correspondence with coating manufacturers, and test reports. (Further discussion of the adequacy of procedures and methods for repair work surface preparation is provided in Coatings Category 4.) The TRT noted that ANSI N101.2 does allow surface preparation other than abrasive blasting to be used for repair work and provides testing methods for qualifying repair coating systems using alternate surface preparation methods. The TRT, after reviewing the supporting data provided by TUEC, observed that there was considerable evidence that power tool cleaning as a surface preparation method for repair work can provide acceptable results, although there was not complete independent laboratory DBA test data for all methods allowed and used at CPSES.

Power tool cleaning does not, generally, provide the same degree and type of surface cleanliness and roughness as abrasive blasting, and if improper tools or improper methods are employed, power tool cleaning can result in a smoothed or polished surface with inadequate roughness to assure satisfactory coating adhesion. The information provided to the TRT by TUEC indicated that the most satisfactory results are achieved with 3M "Clean-N-Strip" or 60 grit or coarser sanding devices; experience at other nuclear facilities and the industry literature support this conclusion. Thus, it is crucial that power tool cleaning be performed only with the proper tools used correctly and that the work be carefully inspected to assure adequate roughness and cleanliness.

The TRT noted that the wording in QI-QP-11.4-5, Rev. 27, permitted the use of improper tools (e.g., "80-grit" and "or equivalent"). The TRT also noted that the inspection records for a large quantity of the repair work performed at CPSES did not provide adequate information to identify the precise tools or methods used, or to demonstrate that adequate surface roughness was achieved. (The TRT also noted that current procedures and inspection methods have remedied this deficiency for current and future repair work.)

The TRT concludes that, although power tool cleaning can result in acceptable coating repair work, there is inadequate evidence to demonstrate that this type of surface preparation for coating repairs at CPSES was acceptable. However, these methods were used only for repair work in limited, but unquantified, areas.

Primer Thickness of 0.5 Mils (AQO-11). This allegation concerns DBA qualification for primer applied at a thickness of 0.5 mils. It is alleged that CPSES DCA 18,489 permits 0.5 mils thickness of primer and that this system is not DBA qualified.

The TRT reviewed DCA 18,489, Revisions 0 and 1, TUEC's correspondence to the TRT on this subject, and CPSES CEL entries Nos. 8 through 15. The TRT noted that Rev. 0 of DCA 18,489 accepted areas of primer at a thickness of 0.5 mils and provided no explanation or justification for this acceptance (such as reference to DBA qualification test data). This DCA was then revised. The TRT observed that DCA 18,489, Revision 1, does not accept or allow 0.5-mil thickness, recognizes that this thickness is unacceptable, and dispositions the affected areas where this thickness was observed by placing them on the CEL. (Further discussion of the use of a DCA, rather than a nonconformance report, for this purpose is provided in Coatings Category 5.) The TRT reviewed the CEL, where entries No. 8 through No. 18 record approximately 100 square feet of surface area exempted because primer thickness was below the specified minimum. (Further discussion of the CEL is provided in Coatings Category 6.)

The TRT concluded that the allegation was correct in that a primer thickness of 0.5 mils initially was allowed at CPSES, and there was no evidence that primer at this thickness was DBA qualified. However, with issuance of Revision 1 of this DCA, areas with this thickness were exempted and not accepted.

Applying Imperial System 11S/1201/11S/1201 to a Thickness of 102 Mils (AQO-12). This allegation concerns the concrete coatings repair/overlap system discussed in the evaluation of for AQO-01. It is alleged that, if the maximum limits given in CPSES procedure CCP-40, Rev. 5, paragraph 4.3.1.2, are used, a 102-mil thickness of the Imperial System 11S/1201/11S/1201 is allowed, and that this system is not DBA qualified.

The TRT reviewed all revisions of CPSES procedure CCP-40, correspondence from TUEC to the TRT on this subject, and related test reports. The TRT recognized that the total area involved could not be quantified and was not entered in the CEL, but based on the review of this information and the investigation of allegation AQO-01, including TRT examinations of coated

concrete surfaces, the TRT found that this system was used only in limited areas, if at all. The TRT found that the test data presented provide some confidence that this system, at this thickness, will perform acceptably, but do not constitute DBA qualification for the system permitted by the procedure.

The TRT concluded that while the allegation was substantiated, because of the limited area involved, this item is without safety consequences.

Reactor Core Cavity Coatings (AQO-13). This allegation concerns DBA qualification of coatings applied to the CPSES reactor core cavity. It is alleged that these coatings have not been DBA tested for the higher radiation exposure levels in this area, and that, in the event of a LOCA, failed coatings would interfere with the engineered safeguards systems.

The TRT reviewed correspondence from TUEC to the TRT on this subject, including correspondence between TUEC and Gibbs & Hill, entry 41 in the CEL, and CPSES NCR C-83-00461, Revision 0, February 11, 1983, and Revision 1, February 15, 1983 (with related March 10, 1983, telex from Gibbs & Hill to TUEC), and also physically examined the reactor core cavity.

NCR-C-83-00461 documented the fact that reactor core cavity coatings had not been DBA qualification tested to demonstrate their ability to withstand the levels of gamma and neutron exposure which will be present in the reactor core cavity. The TRT noted that this NCR has been dispositioned "use-as-is" based upon the reasons provided in the Gibbs & Hills March 10, 1983, Telex. The most significant of these reasons is that failure of coatings in this area will not interfere with the operation of engineered safeguard systems because debris from failed coatings cannot travel from the reactor core cavity, and therefore, qualification for coatings in this area is not needed. The TRT concurred with this reasoning and confirmed it by an examination of the reactor core cavity. Because of the physical configuration of the reactor core cavity and its location in the plant, failed and flaked-off coatings would not flow out of this area during a LOCA. The reactor core cavity is located below all other areas of the Containment Building and below the emergency core cooling system sump screens; the only openings to the cavity are in the ceiling. Because of the higher radiation exposure levels in this area, TUEC has assumed that the coatings will fail, and accordingly, placed this area on the CEL. The TRT reviewed the CEL and confirmed that entry 41 documents 3135 square feet of coatings in this area.

The allegation that reactor core cavities have not been DBA qualified for the environment in that area is substantiated. However, for the reasons given above, the TRT concurred with TUEC's analysis and disposition of this item.

Applying CZ-11 or 191P over P-305, and P-305 over 1201 (AQO-15). This allegation concerns DBA qualifications of nonstandard systems used in repairs where coatings overlap. It is alleged that CPSES procedure CCP-30, Revision 11, paragraph 4.4.3.0, allows CZ-11 or 191P to be applied over P-305 without sanding back to a "mottled" transition, that this same paragraph allows applying P-305 over 1201 and vice versa, and that these systems are not DBA qualified.

The TRT reviewed all revisions of CCP-30, correspondence from TUEC to the TRT on this subject, and CPSES requests for information or clarification (RFICs) which address this subject. The TRT found that the procedures included incorrect and confusing instructions in regard to repairs where coatings overlap and that the RFICs did not clarify the situation. (Further discussion of the adequacy of CPSES procedures is provided in Coatings Category 4.)

TUEC has stated that the overlapping of coating systems, although the resultant systems have not been specifically DBA qualified, is standard practice in the nuclear industry. The TRT concurs with this statement, provided that such areas are limited to the smallest practical size; that such overlaps are performed in accordance with "standard good coating practices" and the manufacturers' instructions and are carefully inspected; and, that there is adequate technical justification for the overlapping systems and the application methods employed.

The TRT evaluated overlapping systems used at CPSES and determined that their limited use was not an item of concern. However, the TRT determined that applying inorganic zinc over an epoxy coating is not technically acceptable and that there is considerable evidence in the industry that this system will not perform satisfactorily. TUEC estimated that the surface area coated with inorganic zinc on top of epoxy ranges from 2,500 to 6,500 square feet; the TRT concurs with this estimate.

The TRT concludes that this allegation is substantiated. However, because of the relatively minor surface areas involved in these overlap systems, the TRT concluded that this item is without safety consequences. (The adequacy of design evaluations and justifications for coatings systems at CPSES is discussed elsewhere in this report.)

5. Conclusion and Staff Positions: Based on the TRT's evaluation, these allegations were largely substantiated. However, the specific coating systems described in these allegations represent a small percentage of the total area coated within the CPSES Containment Buildings. (The significance of the size of this area is discussed in Coatings Category 6.)

The TRT substantiated AQO-01 that adequate testing had not been performed to demonstrate the DBA qualification of the materials applied in the sequence specified in B&R Procedures CCP-40. However, because of the limited area involved, the TRT concludes that the use of these systems was acceptable and would have no adverse safety effects.

The TRT substantiated AQO-02 that nonstandard coatings sequences were not DBA qualified. Unless noted otherwise, the TRT finds this practice acceptable when it is limited to small areas of repair and overlap.

The TRT substantiated AQO-03 that this coating system is not DBA qualified. However, because the item was entered on the Coatings Exempt Log, the TRT concludes that use of this system is without adverse consequences or safety significance.

The TRT partially substantiated AQO-04 in that TUEC did not provide the TRT with adequate documentation to fully demonstrate that this system is fully qualified. However, because the area involved is limited and because the item was placed on the Coatings Exempt Log, the TRT concludes that it will have no adverse safety consequences.

The TRT partially substantiated AQO-05 that TUE did not provide test data sufficient to demonstrate that this system is DBA qualified. However, based on its assessment, the TRT concludes that this system will perform adequately in service and will have no adverse safety consequences.

The TRT substantiated AQO-06 that Imperial Nutec 11S has not been DBA qualified for application over foreign objects. However, because the areas involved were limited, TUEC's treatment of this item was acceptable. Accordingly, this issue is without safety significance.

The TRT has not substantiated AQO-09. Application of inorganic zinc multiple coats is DBA qualified, and application in three coats is not contrary to CPSES procedures.

The TRT has partially substantiated AQO-10 in that adequate evidence was lacking to demonstrate that preparing surfaces with power tools for coating repairs was acceptable. However, because this preparation method was used only for limited areas needing repairs, the TRT concludes that this practice is without safety significance.

The TRT has partially substantiated AQO-11 in that a primer thickness of 0.5 mils was permitted without evidence that primer of that thickness was DBA qualified. However, with the issuance of Revision 1 to the DCA, areas of that thickness were exempted. Accordingly, the TRT concludes that this issue is without safety significance.

The TRT has substantiated AQO-12 in that the test data do not constitute DBA qualification for the system permitted by the procedure. However, because of the limited area involved, the TRT concludes that this item is without safety significance.

The TRT has substantiated AQO-13 that coatings in the reactor core cavities have not been DBA qualified. However, because this item was placed on the Coatings Exempt Log, the TRT concludes that this item is without safety significance.

The TRT has substantiated AQO-15. However, because of the relatively minor surface areas involved, the TRT concludes that this item is without safety significance.

Based upon the TRT's broader investigation of TUEC's design and engineering for the major coating systems at CPSES, as well as the investigations of specific allegations, the TRT concludes that the performance of design and engineering function for coatings was inadequate. Inadequate engineering review and evaluation was evidenced by the deficiencies in the DBA data base and in design control activities and documentation, and can be generally characterized as a failure to make accurate technical assessments

and valid engineering judgments in regards to coatings. The TRT concludes that this engineering performance clearly demonstrates that some personnel assigned by TUEC to perform coatings engineering functions either were not capable or not qualified to perform these functions.

The result of these deficiencies is that TUEC has not demonstrated that the coating systems applied at CPSES are DBA qualified, in accordance with ANSI N101.2 and N512. These deficiencies have also resulted in deficient coating work that could have been prevented by proper design and effective engineering evaluation.

The generic implication of these conclusions is that those responsible for TUEC's coating quality assurance program failed to implement effective design control of safety-related coatings and to detect and remedy deficient implementation; thus rendering the overall effectiveness of the coatings QA program and of basic engineering functions indeterminate. These deficiencies, although not of safety significance in the coatings area must be considered in evaluating the effectiveness of TUEC's overall QA/QC program.

Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. A summary of the followup interviews is included in Section 2.2.3 of this Appendix.

6. Action Required: None.

1. Allegation Category: Coatings 3, Traceability

2. Allegation Numbers: Parts of AQO-36, AQO-34, and AQO-62.

3. Characterization: It is alleged that:

   - The traceability of coating materials was not always maintained (AQO-36).

   - The requirements of American National Standards Institute (ANSI) Standard N45.2.2-1978 were not met for coating material storage (AQO-34).

   - Some paint used at Comanche Peak Steam Electric Station (CPSES) in Service Level I areas was contaminated with grease and oil (AQO-62).

4. Assessment of Safety Significance:

Traceability Not Always Maintained (AQO-36). Because of the general nature of allegation AQO-36, the NRC Technical Review Team (TRT) evaluated the CPSES system for assuring coating materials traceability and the methods used for storing and handling coating materials to determine whether the system and methods could allow traceability to be lost.

The TRT reviewed CPSES nonconformance reports (NCRs) pertaining to coatings, and selected four which bear on the subject of traceability; three of those NCRs are discussed under the review of AQO-62, below. The fourth NCR, C-83-02938, October 27, 1983, directly concerns loss of traceability due to the transfer of coating materials from a mixing area to application locations, without maintaining identification of the material during transport. The TRT's review of this NCR and of associated inspection reports revealed that the nonconforming condition involved small quantities of material that were mixed at one time then divided into different containers to be used for touch up and other coating work on a number of small areas. The NCR disposition section described a change to the method for mixing and distribution to require identification tags to be placed on each container when material was divided after mixing.

The TRT noted that this NCR concerned a relatively isolated incident which involved 12 inspection reports over a 3-day period, October 19-21, 1983, and that the coatings in question were used only for a few small areas. The TRT did not find any other examples of NCRs concerning loss of traceability of coating materials due to this same cause and, because measures were instituted to prevent recurrence, the TRT concluded that this particular incident did not indicate any more general loss of traceability.

A followup interview was conducted with alleger A-11 on February 5, 1985. The alleger indicated that the concern with disposition of NCR C-83-02938 (Allegation AQO-36) would be better characterized as a generic concern with traceability of coatings, rather than the specific NCR disposition. Because, as noted below, the TRT conducted a generic evaluation of coatings traceability, the TRT believes the concerns expressed by the alleger have been adequately considered.

The TRT reviewed Texas Utility Electric Company's (TUEC's) correspondence on this subject. TUEC letter TXX-4201, June 22, 1984, under the heading "Allegation No. 36...Evaluation of Validity" states in part, "Traceability does not exist in all cases for coatings applied prior to November 1981. These coatings, however, are within the scope of the backfit test programs which determines their adequacy." The TRT reviewed NRC Region IV Inspection Report 59-445/81-15; 50-446/81-15 (for inspections performed October 13-16 and 19-23, 1981) and related correspondence and Texas Utilities Generating Company (TUGCO) QA Audit Report TCP-24, October 2, 1981, which is referenced therein. These documents reported deficiencies in records of coating work performed at CPSES prior to November 1981. The backfit test program was established by TUEC for the purpose of determining the adequacy of applied coatings for which existing records were deficient. The TRT observed that backfit test program inspection reports did not record coating material batch numbers or reference any other records where this information was recorded. Further discussion and assessment of the CPSES backfit test program is provided in Coatings Category 1.

The TRT determined that the backfit test program and the backfit inspection records do not restore traceability of applied coatings for which deficient previous records cannot provide traceability. The backfit test program inspections determined the adhesion and thickness of the applied coatings at the time those inspections were performed. These two physical attributes do not demonstrate that the applied coating materials are certified nuclear-grade materials which have been manufactured, stored, mixed, and applied without alteration or contamination, and do not demonstrate that these materials are qualified.

The TRT evaluated the coatings material control and traceability system to determine whether it ensured that coating materials applied at CPSES were traceable to batches which had passed qualification tests. An adequate traceability system must involve: (1) manufacture of the material under a manufacturer's Quality Assurance Program; (2) certification by the manufacturer that the batch manufactured is essentially identical to the batch which was qualification tested; (3) receipt, control, storage, and use of the material by TUEC under a system that assures that the materials are handled and used, as recommended by the manufacturer, in a manner essentially identical to the manner in which the originally tested batch was used; (4) implementation of an inspection and documentation system which provides records to demonstrate all of the above.

The TRT identified the following procedures which include instructions for handling, storage, use, and control of coating materials:

TUGCO procedure CP-QP-8.0 and Brown & Root procedure CP-QP-8.1 provide instructions for receipt inspections at CPSES for all incoming items, including coating materials. Brown & Root procedure CP-CPM 8.1 provides instructions for receipt, storage, and issuance of items, including coating materials. Brown & Root procedures CCP-30, CCP-30A, and CCP-40, which provide overall instructions for performing coating work at CPSES, include specific instructions for storage and dispensing of coating materials and provide storage temperature limitations. TUGCO Procedure QI-QP-11.4-17 provides instructions for monthly surveillance by QC of coating material

storage. TUGCO Procedure QI-QP-11.4-22 provides specific quality control measures which govern the transfer of protective coatings identification numbers when cutting coated stock materials. TUGCO procedures QI-QP-11.4-1, QI-QP-11.4-5, and QI-QP-11.4-10, which provide overall instructions for inspecting coating work at CPSES, include provisions for inspecting coating materials just prior to mixing, and during mixing and application.

The TRT observed that, although most of these procedures had undergone numerous revisions during the construction phase at CPSES, the overall system for coating material storage, handling, and control had remained substantially the same throughout.

The normal site routine for handling coating materials, which is described by the procedures and which was observed by the TRT, is as follows. Incoming coating materials are received and receipt-inspected at the CPSES site warehouse area by site receiving QC inspectors in accordance with standard site receiving routines that apply to all incoming safety-related items. The materials are then issued to the coating storage area near the paint shop. The coating storage area has separate storage for "Q" and "Non-Q" paint materials, is temperature controlled, and is equipped with recording thermometers. The coating storage area and storage functions are operated by coatings craft personnel (not QC), and are subject to monthly surveillance by coatings QC inspectors. When coating materials are needed, they are either mixed in the coating storage area, then transported to the site where they will be applied; or, transported to a mixing area near or at the use location. A coatings QC inspector verifies the acceptability of the material immediately prior to mixing and observes the mixing and application process to verify conformance with requirements. In those cases where mixing is not performed at the application site, the QC inspector who inspects the mixing process attaches a mixing record to the material container to transfer mixing inspection information to the inspector at the application site.

To assess TUEC's implementation of this system, the TRT randomly selected approximately 20 CPSES coating work inspection reports written from 1977 through 1984. The TRT noted that batch numbers of coatings materials used were recorded on these inspection reports, although in some cases there were other deficiencies in these inspection reports which rendered traceability indeterminate. For example, Inspection Report PC01279 documents the application of coatings to an area of the Unit 1 Reactor Building (presumably liner plate) on June 27, 1978, and has an attached mixing record (also identified as PC01279), which documents mixing of coating materials for this area on September 8, 1978. A similar situation exists in Inspection Report PC03650, which documents surface preparation and primer application on December 1, 1977, of coating materials which were mixed on November 22, 1977. In both of these cases, the TRT observed that it was physically impossible for these materials to have been applied as recorded in the inspection reports due to the time discrepancies between mixing and application. (Materials cannot be applied before they are mixed, and can only be applied during a limited "pot life" after mixing before they harden, a period of approximately 8 hours for most materials used at CPSES.) The TRT also observed many other deficiencies in the inspection reports, including inadequate description or location of areas

or items coated, improper changes and corrections, lack of signatures or acceptance initials at interim and final inspection points, and lack of date/time correlation between various sections of the reports. In many of these cases, the TRT observed, the deficiencies noted were serious enough to render the inspection reports unacceptable as quality records and inadequate to provide documentation of material traceability. The TRT noted that some deficiencies in coatings records for the period prior to November 1981, were identified previously in NRC Region IV Inspection Report 50-445/81-15; 50-446/81-15 and TUGCO QA Audit Report TCP-24, October 2, 1981. The TRT also noted that traceability deficiencies for that period have been acknowledged by TUEC in correspondence to the TRT.

The TRT next selected approximately 30 batch numbers of coating materials taken from the inspection reports just discussed and from certain nonconformance reports. The TRT traced these batches back to receiving inspection reports (RIRs) which document their initial receipt at CPSES. The TRT noted during this process that TUEC had an efficient computerized tracking system to allow identification and retrieval of both coating work inspection reports and receiving inspection reports by coating material batch numbers. The TRT found that, in general, the receiving records were in order, and the receiving records packages contained all pertinent information, including copies of coating manufacturers' product identity certification records, as required by ANSI N101.4 and ANSI N101.2. However, the TRT could not locate an RIR or manufacturer's certification for batch number OM1708M of Carboline Carbo Zinc 11 (which was identified in NCR C-81-01724). The TRT also examined the receiving records for the first shipments of coating materials from Carboline, Ameron, and Imperial, the manufacturers of Service Level I steel and concrete coating materials. These RIRs and attachments included evidence of receipt inspections and checklists, manufacturers' certifications, invoices, evidence of source surveillance by Brown & Root or waiver of same, initial storage location at CPSES, and notation of the governing TUEC purchase order.

The TRT next reviewed vendor files for Ameron, Carboline, and Imperial. These files included evidence of initial evaluation and approval of these vendors by Brown & Root based upon QA Department Survey Checklists completed by the vendors, review and approval of the vendors' QA Program Manuals by Brown & Root, and facilities surveys by Brown & Root. These files also included records of regular audits of these manufacturers by Brown & Root from 1977 through 1981. Although these audits occasionally included findings of deficient conditions, documentation was included which demonstrated corrective actions and verification of acceptability via re-audit. The TRT found that since 1981, regular audits have been performed by TUEC, rather than by Brown & Root.

The vendor files also contained copies of the original purchase orders to these vendors together with subsequent changes. The TRT found that these purchase orders were generally complete and acceptable, and included the imposition upon the vendors by TUEC of appropriate regulatory requirements and industry standards (e.g., 10 CFR 50 Appendix B, ANSI N45.2, ANSI N101.4, ANSI N101.2, and 10 CFR 21). The vendor files also included general correspondence sections which showed evidence that there had been vendor participation in a pre-job meeting, as required by ANSI N101.4, and in one

case showed evidence that the manufacturer had transmitted reports of in-house laboratory qualification tests to TUEC. However, the TRT observed that these files did not include complete qualification testing data nor evidence of a review and evaluation of that data by TUEC. (This subject is discussed further in Coatings Category 2, "DBA Qualification Testing.")

The TRT found that the system and its implementation by TUEC, as described above, included most of the important measures required to control materials and to maintain traceability. However, as noted below, the TRT observed certain deficiencies in the procedurally described system and in practices which are not procedurally addressed that could allow traceability to be lost.

Coating storage areas are under the management of craft production personnel (access to stored materials is not controlled independently by QC personnel), and "Q" and "non-Q" coating materials are identified only by their separate storage areas. The result of this arrangement is that once a container of unmixed material is loaded onto a truck for transport elsewhere, it is no longer possible to determine whether the material is "Q" or "Non-Q." An inspection of the containers, performed immediately prior to mixing, would not detect such a mixup in those cases where there is no evident difference in the container labels, such as "Q" materials which had earlier been moved to the "Non-Q" storage area due to a problem with certification or because of a previous loss of control. (Note that no tagging or label change is required when this occurs.) In a similar manner, there is no independent control by QC personnel to assure that unacceptable materials returned to storage from another location are, in fact, returned to "Non-Q," rather than "Q" storage, or to prevent the transfer of materials between adjacent "Q" and "Non-Q" storage areas.

The storage area temperature record charts which are attached to the monthly storage QC inspection reports are not identified as to recorder location (i.e., to show whether the record documents the temperature of the "Q" or "Non-Q" storage area, or some other location).

Some paint mixing slips, described above, are not retained as permanent records, but are discarded after the inspector in the coating application area transcribes the information to his own report. Thus, the original record of the mixing inspection, including the inspector's signature, is lost.

There is no clearly assigned responsibility for maintaining inventory and storage records for coating materials after transfer from the site warehouse area to the coating storage area, and the monthly QC inspection reports do not identify what materials are in storage. Thus, the official records do not show, except by inference, what materials were actually in the storage area during a given time period, nor is there any record to tie the monthly QC surveillance reports and storage temperature record to any specific batch of material.

There is no procedurally required control of coatings materials which have been moved from the coating storage area to various application or mixing areas in the plant. Thus, coatings may in fact be kept in such locations

for extended periods of time without temperature control or records or QC surveillance.

The TRT did not find any specific evidence that these deficiencies resulted in any general loss of material control or traceability (after 1981), except as specifically indicated herein. However, it is evident based on this review that a more rigorous system of coatings material control is necessary to provide confidence that materials do not lose traceability through confusion, alteration, loss of status control, or exposure to environmental temperatures outside of the specified range, during storage and handling on site.

Requirements of ANSI N45.2.2 Not Met (AQO-34). Allegation AQO-34 concerns control of the storage and handling of coating materials. It is alleged that the requirements of ANSI N45.2.2 were not met for the storage and handling of coating materials.

In assessing this allegation, the TRT reviewed the CPSES Final Safety Analysis Report (FSAR), ANSI N45.2.2, and correspondence from TUEC to the TRT on this subject.

The CPSES FSAR, Section 1A (B)-16, specifically states that the requirements of NRC Regulatory Guide 1.38, and thus, ANSI N45.2.2, will not apply during the construction phase. The TRT noted that alternate methods for controlling the storage of coating materials are provided through CPSES FSAR commitments to compliance with ANSI N101.4 and related standards, and are detailed in CPSES Specification 2323-AS-31 and pertinent CPSES procedures. The adequacy of those alternate procedural requirements and their implementation is discussed in the assessment of AQO-36, above.

Application of Contaminated Paint (AQO-62). Allegation AQO-62 concerns alteration or contamination of coating materials prior to application. Such alteration or contamination renders a coating material unqualified and untraceable in that it is no longer essentially identical to the batch which was subject to original qualification testing. It is alleged that some paint used at CPSES in Service Level I areas was contaminated with grease or oil, prior to application, and was applied anyway.

The TRT found and examined three separate instances of possible contamination of coating materials. All three occurrences were documented in nonconformance reports. NCR C-1729, October 2, 1979, concerned the following nonconforming condition: "Carbo-Zinc 11 base-batch 9H5381M was noted for containing what is believed to be grease particles and/or foreign contaminants. Discrepant Qty - 300 gal/5 containers." The dispositon of the original version of this NCR was "use as is" (after straining to remove all contaminants). This disposition was based upon a Telex from the manufacturer, Carboline, which was attached to the NCR. Revision 1 of this NCR, issued on October 17, 1979, changed the disposition to "Return to Vendor," due to the fact that the straining process had been unsuccessful in removing the contaminants. To determine whether any of this contaminated material had been "applied anyway," as alleged, particularly in the time frame between the original issue of the NCR and Revision 1, the TRT examined coating inspection records for work done during September,

October, and November 1979. The TRT found no evidence that the contaminated material, batch 9H5381M, was ever applied. The TRT noted that the Telex from Carboline, which was provided as justification for the strain-and-use-as-is disposition, did not provide any technical explanation by Carboline to indicate why Carboline felt that the presence of the particles would have no adverse affect upon the material, nor any indication that Carboline had reviewed the NCR or was aware that the particles had been identified as "believed to be 'grease'."

NCR C-81-01724, December 14, 1981, and Revision 1 of the same NCR, also dated December 14, 1981, document indeterminate conditions in batches OM2708M, OL2531M, and 1J2791M of Phenoline 305 Catalyst, Part B. Batch OM2708M was identified as being "dark wine color," rather than the normal amber color, and all three batches had unknown particles in the material. This nonconformance report was dispositioned "use as is" based upon communications from Carboline, which were attached to the NCR. The TRT reviewed the information attached to this NCR and found a situation similar to that discussed above for NCR C-1729, in that the Carboline statements did not provide adequate justification or assurance that the identified deficiencies would not have adverse consequences. Carboline's statements did not discuss the nature of the particles, but indicated that these particles probably got into the coating material in their plant. In a Telex dated December 31, 1981, Carboline recommended that the batches not be used until they had determined the cause of the color difference. This recommendation was not included in their letter of January 19, 1982, although there was no indication that the cause had been determined.

NCR C-81-01673, of December 6, 1981, documents a condition observed during mixing of Carboine Phenoline 305, base batch 1J2789M, curing agent batch 1F1054M, and thinner batch 1E1861M. The NCR reports that after repeated hand and power agitation the materials would not thoroughly blend, and dark green pigment floated to the top. The NCR also notes that these materials had already been used to coat nine electrical supports. This NCR was dispositioned "use-as-is," based upon a visual examination of the nine electrical supports which revealed no color abnormalities, and on a statement by the engineer who wrote the disposition that such "pigment float" sometimes occurs but will not affect the cure or integrity of the coating. The disposition further requires that an agitated pot shall be used during application if pigment float is noted.

Upon reviewing this NCR and its attachments, the TRT found no clear explanation of the cause of the observed condition, other than the engineer's statement that pigment float sometimes occurs, especially when higher levels of thinner are used, nor any justification for the statement that this condition will not affect coating cure or integrity. The TRT noted that the inspection of the electrical supports to which the coating had been applied provided some confidence that the cure and integrity were not affected. Nonetheless, it is the TRT's opinion that a more rigorous investigation of possible contamination or alteration, and communication with the manufacturer on this subject, would have been appropriate prior to the issuance of a use-as-is disposition.

Nuclear-certified coating materials are expected to appear and behave uniformly without variation from batch to batch or container to container; any observed differences or irregularities, such as those documented in these NCRs, should be thoroughly investigated to assure that traceability to the original qualification tested batch has not been lost through deficiencies in manufacturing, handling, or use.

5. Conclusions and Staff Positions: Based upon the reviews of individual allegations described above, the TRT concludes that:

Allegation AQO-36 that the traceability of coatings materials was not always maintained is substantiated. The primary significance of this allegation is that, at present, coatings applied in areas included in the backfit test program are of indeterminate traceability.

Allegation AQO-34 concerning noncompliance with ANSI N45.2.2 is substantiated. However, compliance with that standard is not required by the CPSES FSAR. Therefore, this allegation, as stated, has neither safety significance nor generic implications. The TRT noted that alternate methods for controlling storage of coating materials were provided by TUEC procedures in compliance with ANSI N101.4. The adequacy of those procedures and their implementation is discussed above in the assessment of AQO-36.

Allegation AQO-62 that coating materials which were contaminated with grease were applied at CPSES was not supported by the TRT's investigation. In the one instance where "grease" contamination was observed, the material was returned to the vendor and the TRT found no evidence to indicate that any of this contaminated material was applied. Therefore, although partially substantiated, this allegation has neither safety significance nor generic implications.

However, in the investigation of the subject of contaminated materials in general, the TRT found instances of coatings which had been applied with unknown contaminants or which exhibited other unusual and unexplained properties. The TRT found that in these other cases, the operation and documentation of the nonconformance reporting system at CPSES was inadequate to demonstrate the cause of the irregularities, to provide adequate technical justification for use-as-is dispositions for the deficient materials, or to address and correct whatever fault in the manufacturing, handling, or materials control processes produced the deficient materials.

All three allegations assessed raise questions about TUEC's material control and traceability system. Based on its review of that system, the TRT concludes that the material control system, as it is implemented currently at CPSES, provides general control and assurance of traceability for most coating materials, but is not sufficiently rigorous to assure traceability for all coating materials. The primary area of concern, as discussed above, is that materials storage and issuance routines do not include the necessary controls to assure segregation of "Q" and "Non-Q" materials and to prevent the use in Service Level I areas of materials designated "Non-Q." The TRT was not able to identify specific incidents wherein this lack of rigorous control had resulted in misuse of materials;

however, procedural changes would be needed to prevent such incidents in the future. (The subject of procedures is discussed further in Coatings Category 4.)

The TRT determined that the material control system was not adequately implemented prior to November 1981. NRC Region IV Inspection Report 50-445/81-15; 50-446/81-15 has identified violations concerning inadequate inspection and documentation practices for coatings work prior to November 1981, which resulted in loss of material traceability. The TRT has determined that the corrective action performed by TUEC to date (i.e., the backfit test program) has not restored material traceability. These deficiencies, although not of safety significance in the coatings area, must be considered in evaluating the effectiveness of TUEC's overall QA/QC program.

Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. A summary of the followup interviews is included in Section 2.2.3 of this Appendix.

6. Actions Required: CPSES nonconformance reports (NCRs) C-81-01724 and C-81-01673 provide "use-as-is" dispositions for discrepant coating materials, with inadequate technical justification for the disposition. Accordingly, TUEC shall provide adequate technical justification to demonstrate the acceptability of the batches of coating materials listed in these NCRs or, alternatively, TUEC shall identify and quantify the areas where these batches were used and place these areas in the coatings exempt log. Additionally, TUEC shall review all other NCRs which concern discrepant or irregular conditions in coating materials. For any such NCRs which were dispositioned "use-as-is," TUEC shall identify the batches and provide adequate technical justification for their acceptance, or identify and quantify the areas where the batches were used and place these areas on the coatings exempt log. The coatings exempt log will be used in planning future inspections of coatings consistent with the guidelines in Appendix L.

1. Allegation Category: Coatings 4, Coatings Procedures

2. Allegation Number: Parts of AQO-01, AQO-02, AQO-03, AQO-04, AQO-05, AQO-06, AQO-07, AQO-08, AQO-09, AQO-10, AQO-11, AQO-12, AQO-15, AQO-17, AQO-18, AQO-19, AQO-20, AQO-23, AQO-24, AQO-31, AQO-34, AQO-36, AQO-38, AQO-39, AQO-40, AQO-41, AQO-42, AQO-43, AQO-44, AQO-45, AQO-48, AQO-49, AQO-51, AQO-58, and AQO-62.

3. Characterization: It is alleged that:

   a. Comanche Peak Steam Electric Station (CPSES) coating work procedures and instructions allowed the use of coating systems and application methods that were not Design Basis Accident (DBA) qualified. The instances identified in the allegations are:

      - Procedure CCP-40, paragraph 4.3.1.2, allows application of Imperial coatings in the sequential order 11S/1201/11S/1201 or 11S/1201/11/1201 (AQO-01).

      - Nonconformance Report (NCR) C83-01752, June 23, 1983, and Table A2 in Appendix A of CPSES specification 2323-AS-31, allow repair coatings to be applied in sequences different from the original application sequences (AQO-02).

      - Design Change Authorization (DCA) 17,142, Revision 2, allows application of Carboline Phenoline 305 (P-305) over another manufacturer's epoxy coating (AQO-03).

      - DCA 12,374, Revision 1, allows Carboline Carbo Zinc 11 (CZ-11) to be topcoated with Imperial 1201 (AQO-04).

      - Procedure CCP-30A, Revision 2, paragraph 1.3.1, allows application of P-305 over Ameron Dimetcote 6 (D-6) (AQO-05).

      - Procedure CCP-40, Revision 5, paragraph 4.1.1.3, allows application of Imperial Nutec 11S surfacer over foreign objects embedded in concrete (AQO-06).

      - Inorganic zinc application in three coats is allowed (AQO-09).

      - DCA 18,489 allows primer to be applied to a thickness of 0.5 mils (AQO-11).

      - Procedure CCP-40, Revision 5, paragraph 4.3.1.2, allows the Imperial coating system 11S/1201/11S/1201 to be applied to a thickness of 102 mils (AQO-12).

      - Procedure CCP-30, Revision 11, paragraph 4.4.3.0, allows CZ-11 or Carboline 191 primer (191P) to be applied over P-305, and P-305 to be applied over Imperial 1201 (AQO-15).

   b. Coating work procedures and related documents include instructions which are technically incorrect. Specific allegations are:

- NCR C83-01986 provides a repair disposition for cracking and flaking of concrete coatings which will not remedy the cause of the deficiencies (AQO-07).

- Procedure CCP-30, Revision 11, allows inorganic zinc primer to be applied over zinc residue, a practice which will cause adhesion problems and prevent galvanic action (AQO-08).

- TUGCO procedure QI-QP-11.4-5, Revision 27, paragraph 3.2.2.3, permits acceptance of nonqualified and technically inadequate power tool cleaning methods for surface preparation (AQO-10).

- The method used to remedy high dry film thickness (DFT) of CZ-11 will result in poor adhesion of the topcoat (AQO-38).

- Applied P-305, 1 and 2 years old, was topcoated with new P-305 with little or no surface preparation (AQO-39).

- Residues resulting from power tool cleaning of surfaces were removed by improper methods (AQO-40).

- A foreign cleaning solution was used to wipe surfaces immediately prior to repairs (AQO-41).

- The methods used at CPSES to verify the cure of inorganic zinc primers are not adequate, and inorganic zinc primers are not properly cured prior to topcoating (AQO-43).

- The "nickel test" for verifying the cure of inorganic zinc primers prior to topcoating was not performed properly (AQO-44).

c. Backfit inspection procedures and methods were inadequate. Specific allegations are:

- QC inspectors were not allowed to identify visual defects during backfit inspections (AQO-18).

- TUGCO procedures QI-QP-11.4-23 and QI-QP-11.4-24 are very vague regarding the way that backfit inspections are to be conducted (AQO-19).

- Adhesion tests of protective coatings were not properly performed (AQO-20).

- Excessive thinning of P-305 resulted in a weak and brittle film and made it impossible to obtain a Tooke gauge reading (AQO-51).

d. Coatings were applied to surfaces where they should not have been applied. Specific allegations are:

- "Q" coatings have been placed over rusty, scaly, unprepared metal surfaces inside pipe supports made of tube steel without end-caps (AQO-24).

- Imperial 11S and 1201 were applied over duct tape and foam rubber on Richmond Inserts (AQO-42).

- Coatings were applied over joints which were filled with foam (AQO-48).

- Overspray was allowed in areas which had been inspected previously (AQO-49).

e. Quality Control (QC) inspections were inadequate. Specific allegations are:

- Tests of the cleanliness of compressed air used for spray application of coatings were invalidated due to the practices of production personnel (AQO-17).

- The coatings QC program is inferior to such programs at other nuclear power plant projects (AQO-23).

- QC management interpreted an SSPC-SP-6 blast requirement given on a DCA as "do the best you can" and told the QC inspectors "not to worry" about difficult access areas (AQO-31).

- Repairs of defects have been accomplished with no reinspection of the defects (AQO-45).

- QC inspection procedures require that inspections be performed with inadequate light (AQO-58).

f. Procedures were inadequate to assure coating materials traceability. Specific allegations are:

- The requirements of ANSI/ASME N45.2.2-1978 were not met for material-storage (AQO-34).

- The traceability of coatings materials was not always maintained (AQO-36).

- Some paint used in Service Level I areas was contaminated with grease and oil prior to application and was applied anyway (AQO-62).

4. Assessment of Safety Significance: The majority of allegations in this category address both DBA qualifications and procedures which may have permitted the application of non-DBA qualified coatings. The DBA aspects of these allegations are addressed in Category 2.

In assessing these allegations, the NRC Technical Review Team (TRT) reviewed the procedures and instructions which governed the performance and inspection of protective coating work to determine the acceptability of those procedures and instructions and to verify the inclusion of appropriate quantitative and qualitative acceptance criteria for determining that important activities were satisfactorily accomplished. The TRT

reviewed the measures established to control the review, approval, and issuance of instructions and procedures and their revisions. The TRT also observed coating work and reviewed applicable records to determine whether important activities had been accomplished in accordance with the governing procedures and instructions.

The TRT performed a detailed review of procedures related to specific allegations grouped in several generic or functional areas. This review included an evaluation of both the adequacy of the written procedures and the normal practices followed when performing coating-related activities. Many of these allegations have also been considered separately in other Coatings categories; they are included here for consideration of their procedural elements.

General Review of CPSES Coating Work Procedures and Procedure Control System. To evaluate the methods used to control the review, approval, and issuance of instructions and procedures and their revisions, the TRT interviewed responsible supervisors, engineers, and managers and reviewed correspondence and applicable procedures. The TRT found that work instructions and requirements for coatings applied at CPSES were provided by Brown & Root (B&R) procedures CCP-30, CCP-30A, and CCP-40. Inspection methods and requirements were provided by a number of procedures with QI-QP-11.4 designations; specific inspection procedures and requirements are identified below.

The TRT reviewed the following Texas Utilities Generating Company (TUGCO) procedures, which provide requirements for the review, approval, and issuance of procedures used for coatings inspection:

- CP-QP-3.0, Revision 5, "CPSES Site Quality Assurance/Quality Control Organization."
- CP-QP-6.0, Revisions 2, 3, and 5, "Preparation of Quality Procedures and Instructions."
- CP-QP-7.1, Revisions 2, 6, and 9, "Issuance and Control of Quality Procedures and Instructions."

The TRT reviewed the following B&R procedures, which provide requirements for the review, approval and issuance of procedures for coating work operations:

- CP-CPM-6.1, Revision 4, "Preparation & Approval of Construction Procedures & Instructions."
- DCP-3, Revision 18, "CPSES Document Control Program."

Although the TRT found that these procedures were implemented in a manner that satisfied specific requirements, they did not provide adequate controls for coating work in the following areas:

- Inspection procedures reference construction procedures and require inspectors to verify requirements or use methods described only by the

construction procedures. However, the TRT found that these referenced construction procedures are not issued to inspection personnel as controlled copies. (See the discussion of allegation AQO-44.)

- The TRT found that the qualifications of personnel who review and approve procedures do not demonstrate their ability to perform these functions. (See Coatings Categories Nos. 2 and 7.)

- In the CPSES FSAR, TUEC commits to compliance with ANSI N101.4-1972. This standard requires that the coating manufacturer approve application procedures. The TRT found that such approvals are only periodically obtained for construction procedures, and that such approvals are not controlled in a manner adequate to assure their proper use and retention. Further, the TRT found no evidence of manufacturer approval for important revisions to requirements.

Review of Individual Allegations.

a. Allegations AQO-01, AQO-02, AQO-03, AQO-04, AQO-05, AQO-06, AQO-09, AQO-11, AQO-12, and AQO-15 are all concerned with Design Basis Accident (DBA) qualifications of coating materials, systems, and procedures. The allegations, in general, are that the governing procedures and instructions allowed the use of coating systems and application methods that were not DBA qualified. Most of the allegations in this group concern nonstandard coating systems used for coating repairs or overlaps between different systems or between repairs and the original coatings.

   A detailed evaluation of each of these allegations is provided in Coatings Category 2. The following is a summary of the TRT's findings in regards to these specific allegations, as reported in Coatings Category 2.

   The TRT found that the coating systems described by the allegations in this group, except for AQO-9, were not supported by adequate DBA testing data. However, the systems described by allegations AQO-03, AQO-04, and AQO-11 were properly handled by TUEC by entering the affected items into the protective coatings exempt log (CEL). Consequently, the TRT found it unnecessary to review the procedural elements of allegations AQO-03, -04, and -11. The systems described in allegations AQO-01, AQO-02, AQO-05, AQO-06, AQO-12, and AQO-15 were used only in limited areas of coating overlaps and repairs.

   Allegation AQO-09 is unsubstantiated in that application of inorganic zinc in three coats is not a violation of procedures and is not technically incorrect or contrary to data provided by DBA testing.

   The TRT's evaluation of these allegations in Category 4 focused upon the use of coating systems for which DBA qualification testing data were inadequate. The TRT was concerned with the adequacy and appropriateness of procedures and methods which permitted the use of these nonqualified coating systems. In investigating this subject, the TRT reviewed pertinent CPSES procedures and specifications, referenced

below, the specific design change authorizations (DCAs) and related supplementary instruction documents described in the allegations, and the governing American National Standards Institute (ANSI) standards, ANSI N101.4, N101.2, and N512. The TRT also evaluated the subject of coating system overlaps, interfaces, and repairs, from a technical standpoint and with consideration of standard industry practices at other nuclear power plants. The governing ANSI standards provide specific methods for qualification testing and evaluation of coating systems, and ANSI N512, section 5, "Repairability and Maintenance Test," provides for testing of repair systems and methods in accordance with the same test methods and evaluation criteria which are used for testing the original coating systems. The TRT found that throughout ANSI N101.2 and N512 reference is made to the coating manufacturer's recommendations as a basis for procedures for coating work, including repairs, both for the preparation of test specimens and for the performance of actual coating work in nuclear plants.

The TRT recognizes that coating manufacturers' recommended procedures for the use of their products cannot be comprehensive enough to address every possible circumstance that may occur during the use of those products. The TRT also recognizes the physical impossibility of performing complete, independent DBA testing for every possible coating method, repair system, or combination of coating materials which may occur where different coating systems interface in actual field applications. The TRT acknowledges that standard industry practice has been to accept the use of nonstandard, non-DBA-tested systems for overlaps and interfaces, while limiting such areas to the smallest practical size. Nonetheless, the TRT considers it to be important that such nonstandard coating systems be evaluated for technical viability and to assure they do not include materials, methods, or subsystems which have been shown by previous testing to be incapable of withstanding DBA conditions. It is also important that such special cases are explicitly addressed in procedures and instructions which are approved by technically qualified individuals and by the coating manufacturer, as required by ANSI N101.4.

The TRT determined that TUEC's system for review of procedures by technically qualified personnel and by the coating manufacturers was inadequate, as discussed under "General Review of CPSES Coating Work Procedures and Procedure Control System" above, and Coatings Category 2. The TRT also determined that TUEC's procedures and instructions in regards to special coating systems for overlaps and repairs, were complex, confusing, inappropriate, and inadequate in many cases.

Allegations AQO-02 and AQO-15 are concerned with procedures for interfaces between coating systems applied over steel where repairs are performed and where different coating systems join. The TRT found that interfaces were first procedurally addressed in B&R procedure CCP-30, Revision 9, DCN 3, November 16, 1981, paragraph 4.4.3.0. (The TRT noted that earlier instructions did include a requirement to feather the edges of repaired areas.) The TRT reviewed the evolution of this procedural requirement through many subsequent revisions and supplementary instructions, including: a Brown & Root request for

information or clarification (RFIC), unnumbered, January 7, 1983; CPSES NCR C83-01752, July 5, 1983; CCP-30, Revision 11, August 16, 1983; CCP-30, Revision 11, DCN 2, October 19, 1983; RFIC, unnumbered, October 20, 1983; CCP-30, revision 11, DCN 4, November 8, 1983; CCP-30, revision 12, March 4, 1984 (wherein the requirements are moved to paragraph 6.1.3). The TRT observed that these changes, revisions, and clarifications involved changes in the applicability of interface instructions to different cases, changes in limitations on the width of interface areas, explanations of which coatings were permitted to be applied over which other coatings, and the like.

The TRT found that many of these changes did not provide improvement or clarification, but caused confusion and raised additional questions. Numerous versions of these instructions included the statement: "Within the interface area, overlapping of <u>any</u> materials or systems is acceptable." Certain unqualified combinations of coatings such as the application of one manufacturer's qualified epoxy on top of another manufacturer's qualified inorganic zinc, or the overlapping of one manufacturer's epoxy onto another's (within certain total thickness limitations), can reasonably be expected to cause no difficulty, based upon industry experience and inferences from related test data. On the other hand, certain combinations and sequences of materials are technically incorrect; for example, inorganic zinc applied on top of epoxy will not exhibit adequate adhesion, and excessive thicknesses of either zinc or epoxy, which may occur at overlaps between systems or surrounding repairs, may result in cracking or flaking, or both. The net result of the continuously changing and confusing instructions in this area is that existing overlap areas can include every possible combination and sequence of coating materials ever used because the degree of control over application in any given overlap area is impossible to determine. The TRT determined that this situation could have been prevented by clearly written instructions which delineated, at the outset, certain combinations of materials that were permissible at interfaces and certain combinations that were not, and requirements for extra care in application and inspection of interfaces to assure that these requirements were met

A similar situation exists in regards to allegation AQO-06 on the subject of coatings applied over foreign objects embedded in concrete. The TRT recognizes that small areas of embedded "wood fuzz," metal objects, and the like are sometimes found in concrete, that procedures must address how coatings should be applied in such cases, and that it is not necessarily practical or possible to obtain complete DBA testing data for every possible circumstance. In examining applicable procedures and correspondence from TUEC in regards to this allegation, the TRT found considerable evidence that TUEC had considered the subject and obtained manufacturer's recommendations. However, this information does not always appear in the appropriate procedures.

TUEC's letter TXX-4201, June 22, 1984, includes a copy of an Imperial Report 462-1-81 of Oak Ridge National Laboratories DBA testing. This report indicates that Imperial Nutec 11S provides reasonably good performance over abrasive-blasted steel surfaces, but inadequate

performance over power-tool-cleaned steel surfaces, and includes Imperial's recommendations that 11S should not be applied over power-tool-cleaned steel surfaces with suitable roughness greater than 2 square inches. However, B&R procedure CCP-40, revision 5, allows the application of 11S over embedded steel objects of up to 4 square inches which have been ground flush or smooth. Regardless of the fact that 11S over steel is not a qualified system, and regardless of the fact that the areas involved are minor, although numerous, the TRT considers that proper technical evaluation should have resulted in a procedural requirement to assure that small steel objects embedded in concrete were adequately roughened by localized abrasive blasting or other methods, prior to the application of 11S.

b. Allegations AQO-07, AQO-08, AQO-10, AQO-38, AQO-39, AQO-40, AQO-41, AQO-43, and AQO-44 are all concerned with procedures, instructions, and related documents which provide methods and requirements for performing coating activities which are alleged to be technically incorrect. Although some of these allegations are evaluated in other coatings categories, they have been included here, as well, for the purpose of evaluating the adequacy of the related procedural requirements.

Repair of Cracked Concrete Coatings (AQO-07). This allegation identifies NCR C83-01986, concerning the cracking of concrete coatings, and disputes the disposition of the NCR. The disposition states, in part, that "cracking of coatings is due to excessive stresses in the coating during drying and curing," and directs repair of cracks in accordance with existing procedures. It is alleged that this repair method will not remedy the condition that caused the cracks and that the cracks may recur.

The alleger has identified the underlying cause of this nonconforming condition to be foreign matter in the concrete beneath the coatings. (This general subject, embedded foreign materials, is discussed in detail under AQO-06, above, and in coatings Category 2.) During its overall examination of coated concrete surfaces at CPSES, the TRT did not observe any recurrence of cracking. Foreign matter beneath the coatings is no longer visible.

The TRT also reviewed documentation showing that the cracked coatings in the areas described in the NCR had been repaired. The TRT examined B&R procedure CCP-40, Revision 5, which was the governing procedure in effect, and found that repair methods were described in paragraph 4.3.2.5. The TRT determined that these repair provisions are generally in accordance with the manufacturer's recommendations and generally accepted coating repair practices. The TRT determined that the documented disposition was an acceptable remedy for the deficiencies reported in NCR C83-01986.

The TRT considered whether TUEC's original application methods included adequate measures to prevent recurrence. TUEC letter TXX-4201 responding to this allegation states, in part, "The preventative measure to preclude recurrence of this condition is the proper

application with emphasis on control of film thickness (see manufacturer's bulletin attached)." The referenced attachment is a bulletin from Imperial of January 19, 1983. TUEC letter TXX-4249, August 10, 1984, states that specific procedural revisions were not necessary because CCP-40 "was already in accordance" with these application parameters.

The TRT compared the statements of Imperial's January 19, 1983, bulletin to the requirements of CCP-40, Revision 5, and found that the bulletin identifies film thickness, topcoat times, and thinning as controlling parameters which affect cracking. The TRT found that CCP-40, Revision 5, contrary to the manufacturer's instructions:

(a) contains no requirements for additional curing of Imperial Nutec 11 applied 10 to 20 mils thick or Nutec 11S applied in excess of 35 mils thick (as may typically occur at interior corners, bug holes, etc.);

(b) does not provide an equivalent test of hardness prior to recoating thicker areas of Nutec 11 or Nutec 11S;

(c) employs non-conservative interpolations of the manufacturer's curing schedule for Nutec 11, Nutec 11S, and Reactic 1201.

The TRT requested that responsible site construction engineering personnel supply other applicable manufacturer's instructions, and received Imperial's application instructions, dated August 7, 1981. The TRT compared these instructions to B&R procedure CCP-40, Revision 5, and found conflicts between the manufacturer's instructions and the procedure. Examples are:

(a) The procedure provides for concentrations of tri-sodium phosphate (TSP) for washing concrete surfaces which are well in excess of the manufacturer's recommendation, does not require that the TSP be mixed with warm water, and does not require pH testing after rinsing the TSP from the concrete.

(b) The procedure does not provide for a final blowdown of the prepared surfaces with oil-free compressed air.

(c) The procedure does not provide equivalent treatment of concrete surfaces on which Nutec 10 was used as a curing membrane.

(d) The procedure permits application at relative humidity levels above 85%.

(e) The procedure uses non-conservative interpolations for curing times.

(f) the procedure provides that up to 16 mils of Reactic 1201 may be applied (the manufacturer's recommended maximum is 12 mils).

(g) The procedure does not require that high film thickness, runs, and sags be abraded at least 2 mils below the specified maximum thickness.

Zinc Over Zinc Residue (AQO-08). It is alleged that there will be coating adhesion problems and that the necessary galvanic action will fail to occur in areas where inorganic zinc primer has been applied over steel which has a metallic zinc residue in the profile of the steel. Such an application is permitted by B&R procedure CCP-30, Revision 11, paragraph 4.1.3, which states: "shadows of tight residue of primer which may remain in the profile of the previously prepared substrate are acceptable."

The TRT reviewed test data provided by TUEC in correspondence to the TRT, and compared the procedures governing the repair of inorganic zinc coatings with methods that have been used successfully at other nuclear facilities. The TRT observed that there was adequate test data to demonstrate that inorganic zinc could be applied over itself and over steel and would exhibit adequate performance provided that proper procedures were followed both for cleaning and preparing the surface prior to application and for applying the new inorganic zinc coating. The TRT did not find any evidence that the application of inorganic zinc over tightly adhering residues of existing inorganic zinc on properly prepared steel would have any adverse impact upon adhesion or galvanic action. The TRT determined this was an acceptable, proven application technique.

Coatings Applied Over Surfaces Cleaned by Power Tools (AQO-10). This allegation concerns repair or touch up coating work in which coatings are applied over surfaces cleaned with power tools. TUGCO instruction QI-QP-11.4-5, Revision 27, paragraph 3.2.2.3 states: "Surfaces that have been power tooled with '3-M Clean-N-Strip,' 80-grit or coarser 'flapper wheels,' sanding discs, 'roto peens,' or equivalent provide acceptable surface profile." It is alleged that these methods will not result in a DBA-qualified coating system but will provide a smoothed surface with inadequate surface roughness and, therefore, inadequate adhesion of subsequent coatings. (This subject is discussed in detail in Coatings Category 2.)

To evaluate the adequacy of the procedural requirements affecting power tool cleaning for touch up work, the TRT reviewed relevant CPSES procedures, manufacturers' recommendations, test data, and correspondence from TUEC to the TRT and between TUEC and the manufacturers.

The TRT considers that power tool cleaning as an alternative surface preparation method for touch up and repair work, while inferior in general to more rigorous methods, such as abrasive blasting, is normal industry practice for minor repairs and can produce acceptable results. Acceptable results are dependent upon appropriate methods and procedural instructions for performing and inspecting the work to assure the resulting surface is adequately cleaned and roughened to provide good adhesion.

In reviewing TUEC's letter TXX-4201, test data and attached correspondence, the TRT noted that all available data indicated that good adhesion over power-tool-cleaned surfaces is dependent upon the use of the proper tools, specifically 3M "Clean-N-Strip" or 60 grit or coarser sanding devices. The TRT found that the allegation that the methods permitted by the section of QI-QP-11.4-5 quoted above, (i.e., "80-grit or coarser" and "or equivalent") will provide a smoothing or polishing action rather than adequate roughness for proper adhesion, is technically correct. These tools will not provide adequate surface roughness, and the instructions to inspectors that surfaces prepared by such methods are acceptable were inappropriate.

The TRT also noted that the instructions for performing repair work provided in B&R procedure CCP-30, Revision 11 (which was in effect at the same time as QI-QP-11.4.5, Revision 27, quoted above), contained the same technically incorrect listing of tools to be used to perform the work. The TRT found that there was no requirement for inspection or documentation to determine the extent of roughness or the specific tools which had been used. Therefore, the TRT could not determine to what extent, if any, power-tool-cleaned surfaces were unacceptably smooth due to the use of 80-grit sanding devices or their equivalents. However, the TRT recognizes that power tool cleaning was used only to prepare surfaces for repair so that the total involved is relatively minor. The TRT reviewed the current revisions of CCP-30 and QI-QP-11.4-5 and found that this problem has been corrected through specification of the proper tools for power tool cleaning and a requirement for inspection of power-tool-cleaned surfaces for adequate roughness by comparison against an approved visual standard.

Grinding Excessive CZ-11 DFT (AQO-38). Allegation AQO-38 is concerned with the use of power grinding to reduce unacceptably high thickness of applied CZ-11 to an acceptable thickness. It is alleged that this method will result in a burnished or polished surface that would cause poor adhesion of the topcoat to the zinc.

The TRT reviewed relevant CPSES procedures, correspondence from TUEC, recommendations of the manufacturer, and industry standards. The accepted method for remedying high DFT of inorganic zinc is by abrading, sanding, screening, or performing other appropriate mechanical methods to reduce the thickness to acceptable levels. TUEC's procedures specify these methods. Burnishing or polishing effects on the zince resulting from these methods generally have no appreciable adverse impact on the subsequent physical and chemical adhesion of the topcoat to the zinc coating. Adverse effects upon topcoat adhesion will be increased, however, if the inorganic zinc has aged for several years prior to being power ground to reduce thickness.

Recoating P-305 (AQO-39). This allegation is concerned with the methods used to prepare previously applied Phenoline 305 (between 1 and 2 years old) prior to applying a topcoat of new P-305. It is alleged that the solvent wipe method used to prepare the old coating does not constitute adequate surface preparation.

The TRT reviewed relevant procedures, correspondence from TUEC, and the manufacturer's recommendations. The TRT found that the solvent wipe method is in accordance with the manufacturer's instructions (Imperial Report 462-1-81), provided in TUEC correspondence TXX-4201. The TRT found no evidence that solvent wiping as a surface preparation method under these circumstances was inadequate, improper, or would have any adverse affect on performance of the coatings.

Removal of Debris from Power-Tool-Cleaned Surfaces (AQO-040). This allegation is that certain cleaning requirements are not satisfied. The allegation references TUGCO procedure QI-QP-11.4-5, Revision 27, paragraph 3.2.2.d, which requires that inspectors verify that blasted or power-tool-cleaned surfaces have been adequately brushed or vacuumed to remove cleaning debris prior to coating application. The allegation states that power-tool-cleaned surfaces were never cleaned, as specified, and that instead these surfaces were blown down with compressed air or wiped with rags. The concern of this allegation is that surfaces might become contaminated with oil, water, or lint by the practice of removing debris with compressed air or rags.

In letter TXX-4201, TUEC observes that the same procedure requires inspection to verify that cleanliness criteria are satisfied after removal of cleaning debris. The TRT determined that such visual inspection is generally adequate to detect substantial quantities of oil, water, and lint; however, the TRT considers that inspection is not an adequate substitute for requirements that minimize or prevent such problems from occurring in the first place.

The TRT reviewed the requirements of B&R Procedure CCP-30, Revisions 11 and 12, which provide that where the entire thickness of the inorganic zinc primer has not been removed, solvent cleaning shall be employed to remove grease and oil on the surface, typically by wiping the area with solvent-dampened rags. The TRT concurs with this practice.

The TRT interviewed ten inspectors and learned that "blowing down" with compressed air had been used to remove cleaning debris, and that solvent wiping was used in a limited manner. The TRT also learned that inspectors will reject any cleaned surface showing contamination by oil, water, or lint.

The TRT considers that the effectiveness of any of these cleaning methods, i.e., brushing, vacuuming, blow down, or wiping, will be determined primarily by the skill and diligence of the craftsman. The TRT considers that brushing, vacuuming and blow down are acceptable for removing debris from surfaces cleaned to bare metal. Air-driven power tools may release small quantities of lubricating oil from exhaust ports, and subsequent solvent cleaning is an acceptable method to remove lubricating oil. However, solvent cleaning of bare metal with rags should be avoided, so that lint does not adhere to the surface.

The TRT concerns about contaminated air supplies are discussed in the assessment of allegation AQO-17, below. The TRT found that existing

procedures do not provide adequate controls to assure that compressed air used to blow down cleaned surfaces is suitably free of entrained oil and water. The TRT was not able to clearly determine the extent to which the practices described by this allegation may have affected coatings. The TRT notes, however, that small quantities of oil, water, or lint undetected on surfaces after final cleaning will usually be revealed during coating application and inspection. The TRT has commented further on this topic in the discussion of allegation AQO-17.

Foreign Cleaning Solution (AQO-41). This allegation concerns the use of a foreign cleaning agent to wipe coated surfaces immediately prior to repairs. It is alleged that the solution used was a hospital disinfectant containing 2% chlorides, a material not allowed by procedures. The implied concern is that chloride-containing materials within the Containment Building might come in contact with stainless steel and result in stress corrosion cracking in the stainless steel.

TUEC indicated in TXX-4201, June 22, 1984, that the material in question was Econolemon Disinfectant Cleaner-Hospital Type, manufactured by Garland Supply Company, Fort Worth, Texas. NRC Regulatory Guide 1.54 prohibits the use of any chloride-containing material for cleaning stainless steel, and requires testing of any material which is to be used for this purpose. However, the TRT found no direct evidence that this material had ever been used on stainless steel at CPSES.

The TRT reviewed procedures CCP-30, Revisions 10 and 11, and CCP-30A, Revisions 2 and 3, and found that certain solvents are specified for use prior to repair of primer and topcoat. The TRT interviewed several QA/QC personnel on the use of this unapproved foreign cleaning solution. The persons interviewed had no knowledge of this material being used prior to repairs on the steel liner plate, nor of this solution being used on any stainless steel inside the Containment Building. One individual informed the TRT that this material had been used for a washdown of applied finish coat on the steel liner plate in the Unit 1 Containment Building, and that NCR C-83-01694 had been written as a result. The interviewed individuals also informed the TRT that these areas were always rinsed thoroughly after such cleaning. The TRT reviewed NCR C-83-01694, and found that it concerned the use of this material over the topcoat only, and there was no indication that the material had been used for repair work as indicated in the allegation.

The TRT reviewed the contents of the disinfectant, and determined that it was a detergent which would have no adverse effect upon the finish coat if the coating was thoroughly rinsed after its use. The TRT found no fault with the governing procedures or with the disposition of NCR C-83-01694.

The TRT also reviewed B&R procedure CP-CPM 9.2, Revision 0, June 25, 1984, which was provided by TUEC in TXX-4249, dated August 10, 1984. The TRT determined that this new procedure provides the necessary

controls to assure that foreign chemical materials do not enter the Containment Building area in the future.

Cure of Inorganic Zinc Primer (AQO-43). Allegation AQO-43 is concerned with improper curing of inorganic zinc primers prior to topcoating and with not following procedures to determine if the primer was properly cured.

The TRT reviewed the procedures which provided work and inspection requirements for curing inorganic zinc primers. All revisions of B&R procedures CCP-30 and CCP-30A describe methods to perform and inspect the curing of inorganic zinc primers. The current inspection requirements are given by TUGCO procedures QI-QP-11.4-5, Revision 29, and QI-QP-11.4-26, Revision 6, which require cure verification.

The TRT found that the methods and requirements provided in the B&R procedures correspond to the recommendations of the coating manufacturers with one exception, which is discussed under allegation AQO-44. A generally accepted practice is to accelerate curing by wetting the primer with water after initial drying. This practice was incorporated into the B&R procedures after April 1981, and the TRT found this procedure was generally employed thereafter. The TRT also interviewed 11 inspectors who are presently employed at CPSES concerning cure verification procedures, and found no evidence to show that curing requirements had not been implemented consistently.

In addition, the TRT determined that the backfit program's adhesion testing (see Coatings Category 1) provides an acceptable measure of confidence that inorganic zinc primers applied prior to November 1981, were adequately cured.

Performance of the "Nickel Test" (AQO-44). Allegation AQO-44 is concerned with the "nickel test," used to verify the cure of inorganic zinc primers prior to topcoating, not being properly performed because of oral instructions from QC supervisors to perform the test by lightly rubbing the coating with the coin and to apply just enough pressure to hold the coin in contact with the surface. The implied significance of the allegation is that improper instructions resulted in the topcoating of inadequately cured primers, and that those primers might fail in service.

The "nickel test" is a generally accepted technique to verify the cure of inorganic zinc coatings, and has been used since the 1940s. Inorganic zinc coatings harden during curing; the "nickel-test" provides a uniform method of assessing the hardness of the inorganic coating. Experts in the field differ slightly in the methods they recommend for performing this inspection; a consensus standard is currently under development by ASTM Committee D 01.48. There is a general recognition in the coatings industry that the results of this test can be interpreted very subjectively.

TUEC letter TXX-4201 states, in part, that "It is our opinion that the "coin test" method described in CCP-30 and CCP-30A conforms with

[the manufacturer's] preferred method for the coin test as described in the attached [Carboline's] letter."

The TRT reviewed TUEC's governing procedures, and found that the use of the "coin test" or "nickel test" to verify the cure of inorganic zinc coatings was initiated in B&R procedure CCP-30, Revision 7, dated May 7, 1981. Paragraph 4.4.1.1.6 of this revision states, in part, that "[The coating] is sufficiently cured for topcoat when the coating may be burnished rather than removed when rubbed with the flat portion of a smooth-edged coin such as a nickel." The statement is maintained substantially unchanged through subsequent revisions, and was incorporated into B&R procedure CCP-30A, Revision 1, and subsequent revisions.

The TRT found that certain inspector qualification examinations require QC inspectors to describe the method of performing the nickel test. The correct response as given by the prepared answer key, corresponds to the procedures.

The TRT found that QC inspectors are not issued controlled copies of CCP-30 and CCP-30A. The nearest available controlled copy of these procedures is maintained in the paint superintendent's office.

The TRT requested that some inspectors demonstrate the "nickel" test or to describe it in detail. The TRT learned that inspection personnel conduct this test by lightly rubbing the inorganic zinc with the flat of a nickel and then visually examine the coating for the presence of burnishing or any removal of the coating. The TRT also found that the procedure employed at CPSES differs from the statement given by the manufacturer referenced in TUEC letter TXX-4201. The letter states: "Put heavy pressure on the coin with the finger tips and rub the coin back and forth (8-10 times)." The procedure used at CPSES does not specify the use of heavy pressure or the number of times the surface is to be rubbed. The TRT was not able to establish the extent to which improperly performed "nickel tests" might have resulted in the coating of partially cured inorganic zinc primers. However, the water curing procedure discussed under allegation AQO-043 is sufficiently effective to eliminate significant concerns of inadequate inspection practices.

c. Allegations AQO-18, AQO-19, AQO-20, and AQO-51 concern inadequacies in the procedures and methods which were employed in the backfit test program (BTP). A detailed analysis and evaluation of the significance of these allegations in regards to effects upon the BTP is provided in Coatings Category 1. These allegations are considered separately here to provide an evaluation of the adequacy of the governing procedures. In evaluating these allegations, the TRT reviewed pertinent revisions of the backfit inspection procedures, TUGCO instructions QI-QP-11.4-23 (Steel Substrates) and QI-QP-11.4-24 (Concrete Substrates), as well as other related inspection procedures.

Visual Defects During Backfit Inspections (AQO-18). Allegation AQO-18 is concerned with inspection for visual defects such as cracking or

blistering; it is alleged that inspectors were not allowed to identify such defects during backfit inspections.

In reviewing the backfit inspection procedures and related NCRs, the TRT found that, although some visual inspection parameters were included in certain revisions of the procedures, that visual inspection per se was not an element of the backfit inspection program. Therefore, inspectors were not supposed to perform visual inspection as part of the BTP. TUEC's letter TXX-4201 provides the explanation that visual inspections were performed separately in accordance with other procedures that governed ongoing inspection work (i.e., TUGCO instructions QI-QP-11.4-5 for steel substrates, and QI-QP-11.4-10 for concrete substrates). The TRT has evaluated the adequacy of the visual inspection requirements of those other procedures under section 4e below. (See Coatings Category 1 for additional information on AQO-18.)

Given the fact that the backfit program was instituted as a remedy for previous deficiencies in performance and documentation of inspections, and that these deficiencies included lack of adequate records of visual inspections, the TRT considers that it would have been appropriate to include visual inspection as part of the backfit program. The lack of such visual inspections created an unnecessary complexity in inspection requirements and records which could have been avoided by including all inspection criteria (DFT, adhesion, and visual evaluation for defects) in a single procedure, and the results in a single report for each area. (See Coatings Category 1, AQO-18.)

Backfit Instructions Vague (AQO-19). Allegation AQO-19 concerns TUGCO instructions QI-QP-11.4-23 and QI-QP-11.4-24, which govern the performance of backfit inspections. It is alleged that these procedures are very vague regarding the way the backfit inspections are to be conducted.

The TRT reviewed all revisions of these procedures, including QI-QP-11.4-23, Revision 0, November 19, 1981, through Revision 13, April 18, 1984, and QI-QP-11.4-24, Revision 0, February 5, 1982, through Revision 7, April 18, 1984. The TRT also interviewed inspectors who had performed backfit inspections and examined records of their training in the performance of these inspections. The TRT found that, although these procedures included detailed instructions in certain areas, there were other areas in which the instructions were incomplete or missing. Examples are:

(a) These instructions are entitled "Reinspection of Seal Coated and Finish Coated Steel Substrates for which Documentation is Missing or Discrepant" (QI-QP-11.4-23), and "Reinspection of Protective Coatings on Concrete Substrates for which Documentation is Missing or Discrepant" (QI-QP-11.4-24). However, neither instruction provides adequate details regarding what plant areas or items the procedures apply to (i.e., which areas or items have missing or discrepant documentation), or provide details on how such areas are to be identified or by whom.

(b) These instructions do not provide detailed operating instructions on the use of the two principal instruments employed for backfit inspections: the Tooke gauge and the Elcometer adhesion tester.

Despite these procedural deficiencies, the TRT considers that these instructions are adequate to permit proper performance of the inspections by individuals who have been trained in the correct use of the instruments and implementation of the procedures. Training and qualification of inspection personnel, including backfit inspectors, have been reviewed separately, and the TRT's evaluation is reported in Coatings Category 7. Although the TRT did find deficiencies in training and qualification of personnel, the TRT could find no evidence that these deficiencies resulted in improper performance of backfit inspections. During interviews with former backfit inspectors, the TRT confirmed that all individuals questioned had an adequate understanding of the proper use of the instruments and the performance of the inspection procedures.

Adhesion Tests Not Properly Performed (AQO-20). Allegation AQO-20 concerns the method used by backfit inspectors to perform adhesion tests of coatings using the Elcometer adhesion tester. It is alleged that the QC inspectors were instructed not to cut the coatings around the adhesion test dollies ("scribing") prior to performing the test, and that this is contrary to the instructions provided by the manufacturer of the instrument. (CPSES specification 2323-AS-31 references these manufacturer's instructions.)

Based upon a review of TUEC's backfit inspection procedures, the specification, the adhesion tester manufacturer's instructions, and correspondence from TUEC, the TRT determined that this allegation was substantially correct: CPSES QC inspectors did not score around dollies, although the manufacturer specifically instructs the user to score around the dollies prior to performing the tests.

The TRT reviewed the results of onsite testing conducted by TUEC to demonstrate that scribing or not scribing does not affect test results. The TRT also solicited input on this subject from qualified individuals in the industry, including persons currently engaged in developing an ASTM standard on the subject of adhesion tests for coatings. Based upon this information, the TRT determined that failure to scribe around the dollies would not have had any appreciable adverse impact upon the validity of test results and was not technically improper.

The TRT noted, however, that in this case TUEC had provided oral directions to the QC inspectors that were contrary to the written instructions (2323-AS-31 and the manufacturer's instructions). The TRT also noted that TUEC has since modified site practice to institute scoring around dollies in compliance with the manufacturer's instructions.

Phenoline 305 50/50 Mix (AQO-51). Allegation AQO-51 concerns the practice of thinning Phenoline 305 (P-305) by adding two quarts of thinner per gallon. It is alleged that this practice caused the

material, when dried, to become as brittle as glass and to lose its impact and abrasion resistance. It is alleged that the material became so brittle that it was not possible to obtain a Tooke gauge reading.

The TRT reviewed TUEC's application procedures, B&R CCP-30 and CCP-30A, and TUEC's correspondence on the subject (with attached letter providing the manufacturer's recommendations) and determined that thinning P-305 up to two quarts per gallon for certain application conditions (i.e., "tie" or "seal" coats, pre-treating sharp edges, and application at relatively low ambient temperatures), was procedurally addressed, in accordance with the manufacturer's instructions, and technically correct. There is no evidence to indicate that thinning the material in this manner will cause the applied coating to become brittle and to lose its impact and abrasion resistance.

The TRT concurred with TUEC's statement in TXX-4201 that any apparent embrittlement which made it impossible to obtain a Tooke gauge reading was more likely the result of a dull tip on the gauge than of deficient characteristic of the coating film. This explanation however raised an additional question in regards to backfit inspection procedures and the use of a Tooke gauge with a dull tip. (Tooke gauge tips must be sharp to provide a smooth cut and an accurate reading.)

Although the TRT did not find any records to demonstrate that backfit inspectors had received specific instructions in this area, during interviews conducted by the TRT all backfit inspectors questioned were aware of the consequences of dull tips on Tooke gauges. The TRT also noted that backfit inspection procedure QI-QP-11.4-23 requires a daily confidence check of Tooke gauges, including an examination for evidence of tip wear.

The TRT did not find any evidence that the "50/50" mix resulted in any deficiency in the coatings applied or that there was any related improper use of Tooke gauge with dull tips.

d. Allegations AQO-24, AQO-42, AQO-48, and AQO-49 concern application of coatings to surfaces where they should not have been applied. In each case the concern is that such misapplied coatings could fail, thereby creating debris which could interfere with the proper operation of engineered safeguard systems.

Allegation AQO-24 concerns Q coatings that have been placed over rusty, scaly, unprepared metal surfaces inside pipe supports made of tube steel without end-caps. The TRT reviewed correspondence from TUEC on this subject, DCA 16,106, and CEL entry 32. The TRT found that entry 32 in the CEL documents 6,000 square feet of CZ-11/P-305 misapplied to tube steel support interiors without proper surface preparation or inspection. The TRT also noted that DCA 16,106, Revision 1, stated that, "Coatings extending into open tube steel members resulting from spray operations performed on the ends and exterior of the member is acceptable."

Allegation AQO-42 concerns coatings which were applied over duct tape and foam rubber in Richmond Inserts. The TRT reviewed correspondence from TUEC on the subject, DCA 12,374, and the CEL. The TRT found that DCA 12,374 downgrades all coatings on Richmond Inserts to specification 2323-AS-30 (Non-Q), and that entry 30 in the CEL documents 2,258 square feet of Richmond Inserts in Reactor Building 1.

Allegation AQO-48 concerns coatings which were applied over "seismic joints" which were filled with foam and were not to be coated. The TRT reviewed correspondence from TUEC on this subject and the CEL. The TRT found that the joints described in the allegation were in fact expansion joints rather than seismic joints, that the total area involved was approximately 125 square feet, and that this item had been entered into the CEL.

In all three cases, the TRT found that TUEC's estimate of the size of the area involved was acceptably conservative, and that entry of the item into the CEL provided an acceptable resolution of the problem.

In evaluating concerns with misapplied coatings, the TRT reviewed the governing specification and all pertinent procedures and instructions. The TRT found that although specification 2323-AS-31 provides a listing of items which require coatings and items which do not require coatings, nowhere in the specification or procedures are there any instructions or requirements for protecting items which are not to be coated or for inspection activities to assure the adequacy of protective measures which are taken. The TRT confirmed this finding through interviews with coatings quality engineering personnel, each of whom stated that no procedural requirements for masking or inspection of masking exist, and that any misapplied coatings which are detected during other inspections are handled on a case-by-case basis.

Allegation AQO-49 concerns overspray of coating materials onto coated surfaces that had previously been inspected. It is alleged that this has been allowed and is commonplace. The TRT reviewed correspondence on this subject from TUEC, reviewed pertinent procedures, and examined completed coating work in Reactor Buildings 1 and 2. The TRT concurs, in principle with the evaluation of this issue provided by TUEC in letter TXX-4201, i.e., overspray is a common phenomenon during the spray application of coatings and is not harmful, provided that adequate methods are employed to detect and correct any excessive or detrimental overspray which occurs. The TRT found no evidence of excessive uncorrected overspray in its examination of finished coating work. However, the TRT noted that the governing procedures do not provide guidelines or instructions for the protection of finished work.

The TRT found that the lack of instructions or methods for masking and protecting items not to be coated, and the lack of inspections for adequate masking, were the cause of the specific deficiencies described in these allegations. The TRT also found that these procedural deficiencies would allow continued and possibly undetected application of coatings to non-specified surfaces which could result

in failure of such misapplied coatings as well as potential damage to sensitive plant equipment from coating activities.

e. Allegations AQO-17, AQO-23, AQO-31, AQO-45, and AQO-58 are all concerned with the performance of quality control inspections for coating work at Comanche Peak. These allegations concern inspections which were not performed or were performed improperly, and which were therefore inadequate to correctly assess the acceptability of the coating work and the applied coatings.

Air Acceptance Invalid (AQO-17). Allegation AQO-17 is that the inspections of compressed air cleanliness prior to conventional spray application of coatings are invalid because production personnel insert cigarette filters into the air line immediately ahead of the test point without the knowledge of QC inspectors, and then remove the cigarette filter after the test. It is further alleged that construction and QC management were aware of the practice. The significance of this allegation is that the use of compressed air containing entrained oil and moisture for sand blasting, blowdown, and conventional spray application, will degrade the applied coatings.

The TRT interviewed inspectors, QC management, and reviewed TUEC's response to this concern given by letter TXX-4201. The TRT found that the alleged practice did occur, but that it has been stopped.

The TRT also found that air supply equipment for Unit 1 was replaced in September 1983, and that the same equipment was moved to Unit 2 in August 1984. During its review, the TRT tested the air supply at a Unit 2 coating operation and found it acceptable.

The TRT found that QC inspectors who perform this check periodically reject compressed air cleanliness, and that replacement of filtering elements is then performed and is adequate to correct the adverse conditions. In the experience of the coatings industry, oil and water in compressed air will not have significant adverse effects on coating performance unless present in sufficient quantities to condense. This observation has resulted in the generally accepted test method, used at CPSES, of holding a clean white blotter in the compressed air stream and then examining the blotter for traces of oil or moisture. CPSES procedures require a 30-second blotter test, which is at the lower limit of the range of periods for which this test is typically conducted.

Oil and water present in sufficient quantities to condense upon the applied coatings are often readily visible to a trained observer without benefit of the blotter test. Unacceptable quantities of water will shorten the pot life of coatings in pressure pots, especially for inorganic zincs, or cause certain discolorations. Water deposited on surfaces by blasting or blowdown will cause rapid "rusting" discoloration. Unacceptable quantities of oil deposited on surfaces by blasting, blowdown, or spray atomization will cause a visible defect known as "fisheyes," or a sliding of the coating known as "creeping," and may produce discolorations of the coating film. Minute quantities

of insoluble oils may be retained within coating films without appreciable adverse effect. Minute quantities of water will transmit out of the coating film.

The TRT examined the current revisions of the applicable TUGCO inspection procedures from the QI-QP-11.4 series. The TRT considers that the procedures provide generally acceptable methods for a properly trained inspector to identify and verify correction of such defects in the applied coating which might result from the use of inadequately clean compressed air. However, the TRT found that procedures do not provide rigorous methods to limit the recurrence of the deficiencies.

Coatings QC Program Inferior (AQO-23). Although this allegation represents a subjective judgment, it is concerned specifically with "standard" inspection methods and techniques. It is alleged that the Comanche Peak Coatings QC inspection program is inferior to programs at other nuclear plants because inspection methods used at other plants are not used at CPSES. The example given in the allegation is the American Society for Testing and Materials (ASTM) tape adhesion test which, it is alleged, was used regularly at another site, but not allowed at CPSES by one of the QC lead inspectors.

The TRT reviewed TUEC's governing procedures, specifications, correspondence from TUEC on the subject, relevant standards, and common practices at other nuclear power plant projects. The TRT found that specific coatings inspection practices and procedures vary somewhat from site to site, depending upon each applicant's or licensee's interpretation of regulatory and industry standard requirements, and on how these requirements were translated into a site-specific quality control program. In terms of the types of inspection techniques, instruments, and methods employed, the TRT found that CPSES was not appreciably different from other sites as to inspections addressed by the coatings QC program.

Specifically in regards to not allowing the ASTM tape adhesion test, the TRT does not consider that this demonstrates that TUEC's coatings QC program is inferior. The TRT did not find that the ASTM tape test was regularly or extensively used at other sites, nor did the TRT find any governing standard or regulation requiring the use of this test. When adhesion testing is performed at nuclear sites, the commonly used method is employing the Elcometer adhesion tester, which is the method addressed by ANSI N512 for testing DBA samples. The TRT found that the Elcometer adhesion tester method is required by CPSES specification 2343-AS-31 and the governing TUGCO quality instructions; it was, therefore, appropriate for TUEC to direct QC inspectors not to use an unspecified alternate method.

Limited Access Areas (AQO-31). This allegation concerns the interpretation of CPSES DCA 13,140, which addresses performance and inspection of surface preparation on steel surfaces which had limited access or which were inaccessible. Revision 2, February 21, 1983, of this DCA, which has been incorporated into the current revision (Revision 2) of specification 2323-AS-31, specifies that limited-access

areas shall be prepared to Steel Structures Painting Council (SSPC) specification SP-10 (near-white metal blast) or equal, if possible, with a minimum requirement of SSPC-SP-6 (commercial blast) or equal. The DCA further specifies that inaccessible areas shall be treated on a "best effort" basis and that QC inspection on inaccessible areas is not required. The DCA includes drawings which illustrate and define "limited access" and "inaccessible" areas. It is alleged that QC management interpreted the SSPC-SP-6 minimum requirement for limited access areas to mean "do the best you can" and stated to QC inspectors that if they could not get to an area, not to worry about it.

The TRT reviewed all revisions of DCA 13,140, specification 2323-AS-31, and correspondence from TUEC on this subject. The TRT recognizes that limited access and inaccessible areas exist in all nuclear power plants, where it is not possible to perform coating work operations and inspection activities in accordance with normal specification requirements. The TRT considers that the requirements in DCA 13,140 provide appropriate instructions for performing and inspecting surface preparation work in such areas. The TRT noted that the changes from Revision 0, to Revision 1, to Revision 2 of this DCA provided progressively more explicit criteria for determining the classification of an area or item as a limited-access or inaccessible area.

The TRT could not confirm that the alleged statements were made by QC management.

The TRT considers that any areas which have been classified as inaccessible or limited-access areas in accordance with this DCA, do not meet the normal specified requirements for Service Level I coatings, and should, therefore, be entered into the CPSES CEL. However DCA 13,140 makes no provision for entry of these areas into the CEL as a justification for the downgraded requirements. In TXX-4262, August 21, 1984, TUEC provided an estimate of approximately 6,100 square feet of surface area classified as inaccessible or limited access, and the TRT found that this figure was acceptably conservative. Further discussion of the CEL is provided in Coatings Category 6.

Reinspection of Repairs (AQO-45). This allegation concerns the reinspection of repairs that are performed to remedy defects in applied coatings. It is alleged that some coating repairs at CPSES were never reinspected and that other coating repairs were not given the same type of final inspection that would have been performed for regular production work. The implied significance of this concern is that repairs which are not reinspected properly may have defects or may sustain damage which would not be detected and corrected.

The TRT reviewed the current governing procedures identified by TUEC, TUGCO QI-QP-11.4.5 and QI-QP-11.4-26, and correspondence on this subject from TUEC to the TRT. The TRT also reviewed all revisions of TUEC's procedures which have governed coatings repair work in the past, including QI-QP-11.4-5, QI-QP-11.4-10, QI-QP-11.4-26, and QI-QP-11.4-27.

The TRT found that the requirements for reinspection upon completion of repair work were not clearly addressed in all cases, although the requirements for inspections to be performed during repair operation were, generally, adequately addressed. An example of an adequate procedure addressing inspection of repairs is found in QI-QP-11.4-26, revision 6, paragraphs 2.10.2 and 2.10.3. These sections provide specific inspection requirements for repair of both major and minor defects, and include requirements to "perform inspection in sec[tion]...2.9" ("Finish Coat Final Acceptance Inspection"). This procedure also includes provisions for a "Steel Protective Coating Inspection Repair Traveler" to document and track repaired areas to ensure completion of all required inspections. An example of an inadequate procedure addressing inspection of repairs is found in QI-QP-11.4-5, Revision 29, May 4, 1984, in which paragraphs 3.7.2 and 3.7.3 do not provide equivalent requirements and do not address performance of "Finish Coat Final Acceptance Inspection" (in accordance with paragraph 3.6 of that procedure) for repairs. Similar deficiencies occur in earlier revisions of the governing procedures. The TRT found that both in current and historical inspection procedures, clear instructions were not always provided for reinspection of repairs.

The TRT noted that TUEC has made a distinction between the inspection requirements for "minor" versus "major" repairs, and this issue was discussed by TUEC in letter TXX-4201, June 22, 1984. Regarding this specific issue, the TRT found that the distinction drawn by TUEC was appropriate, noting that it is consistent with standard industry practice to perform final inspections of minor repairs (such as "touching up" pinholes) while repairs are being made.

The TRT also noted that TUEC has stated in correspondence and interviews that a final visual inspection performed by CPSES engineering in accordance with TUGCO Engineering Division Instruction CP-EI-4.0-51, Revision 1, provides assurance that all coated areas, including repairs, receive a final visual inspection. The TRT reviewed this procedure and found it inadequate for the purpose stated above in that it does not include visual inspection methods, criteria, or adequate documentation of same, and does not require performance of such inspections by personnel who are trained and qualified in these activities.

However, during its visual examinations of coated surfaces within CPSES Unit 1 Containment Building, the TRT found no evidence of inadequate or unacceptable coating repair work, or of uncorrected damage to repaired areas.

Inadequate Lighting for Inspection (AQO-58). This allegation concerns procedural requirements for illumination used to perform coating inspections and cites TUGCO instruction QI-QP-11.4-1 as an example. It is alleged that the instructions provide for inadequate lighting. The implied concern is that inspections performed under inadequate illumination will not adequately assess the quality of the coating and may not identify defects which are present.

The TRT reviewed the governing procedures and specifically examined QI-QP-11.4-1, Revision 20, March 5, 1984, which is currently in effect. Paragraph 3.0 of that instruction states: "Visual inspection of surfaces as addressed by this instruction shall be made at approximately an arms length from the surface being inspected. The area of inspection shall be adequately lighted during the inspection activity. Adequate lighting is defined as the minimum light produced by a two (2) D-cell battery flashlight. Flashlight shall be held perpendicular to the surface during visual inspection." The TRT considers the language of this paragraph to be vague, technically inappropriate, and contrary to recognized standard practice for performing visual inspections of coatings.

Proper practice involves the examination of coatings work from different angles, and sidelighting the surface to identify certain defects (e.g., hackles or protrusions in blasted steel, and blisters, craters, and runs in applied coatings). It is, therefore, important that visual inspections require the use of a movable light source and side lighting of the surface as needed (rather than a requirement to maintain the light "perpendicular" to the surface). The inspector should also have the freedom to vary his distance from the surface (both for overall examinations for shadowing and color uniformity and for closer examination of questionable areas), rather than being restricted to an "arms length from the surface." The language in the paragraph quoted above regarding light intensity can easily be misinterpreted to imply very weak light or no light, but even if it means the light provided by a fully charged, fully functioning two-D-cell flashlight, this may not be adequate in all cases.

The TRT finds that the allegation was substantiated in that TUEC provided inappropriate and inadequate requirements for performing visual inspections in paragraph 3.0 of QI-QP-11.4-1, Revision 20.

Rigorous adherence to the limitations of this paragraph would severely restrict an inspector's ability to adequately perform visual inspections and to identify coatings defects.

f. Allegations AQO-34, AQO-36, and AQO-62 all concern coatings traceability in that they address alleged deficiencies in TUEC's handling, storage, and use of coating materials that would render traceability of applied coating materials to DBA tested batches indeterminate. These three allegations are evaluated and discussed in detail in Coatings Category 3. They have been included for discussion in this report, as well, for consideration of their procedural aspects. A brief summary of these allegations and the TRT's evaluation of each follows:

<u>ANSI Requirements Not Met (AQO-34)</u>. This allegation, concerning noncompliance with ANSI N45.2.2 for coatings material storage, was substantiated but not considered to be significant because compliance with that standard is not required by the CPSES FSAR.

<u>Coating Materials Traceability Not Maintained (AQO-36)</u>. This allegation, concerning failure to maintain coating materials traceability,

was substantiated in regards to areas included in the backfit test program for which previous records were missing or discrepant.

Contaminated Paint (AQO-62). This allegation, concerning contaminated materials being applied, was not substantiated to the extent that the TRT did not find evidence that contaminated materials had been applied.

However, in the TRT's generic review of TUEC's system for control of coating materials (as reported Coatings Category 3), the TRT determined that the procedurally addressed system was inadequately rigorous in several respects.

Brown & Root (B&R) procedure CP-CPM 8.1, Revision 1, "Receipt, Storage, and Issuance of Items," provides requirements for control of stored coating materials prior to issuance to the paint department. However, once materials have been issued from the site warehouse to the paint department, the only storage control requirements are those provided by CCP-30, CCP-30A, and CCP-40. These procedures address storage temperature ranges and the location of "Q" materials in the paint storage warehouse that are segregated from non-Q materials, and little else. These procedures do not address any physical inventory control measures or requirements for moving materials in and out of the paint warehouse. They do not describe controls to assure the continued segregation of Q and non-Q materials when they are moved in and out of the warehouse and are transported to and from different locations on site.

TUGCO procedure QI-QP-11.4-17, Revision 6, "Surveillance of Storage and Handling of Protective Coatings," provides for monthly storage inspection of storage facilities by QC. However, it imposes no requirements for more frequent checks to verify that physical control is maintained in the interim or for control by QC of materials during transport on the job site or for storage at other job site locations.

5. Conclusions and Staff Positions: Based upon its review, the TRT has reached the following conclusions:

a. For allegations concerning DBA qualifications (AQO-01, AQO-02, AQO-03, AQO-04, AQO-05, AQO-06, AQO-11, AQO-12, and AQO-15):

The individual items described in the allegations are not significant because they concerned only minor surface areas, were properly corrected by TUEC, or were not substantiated. However, Coatings Category 2 also addresses TRT technical concerns related to DBA qualification of the major coating systems which are beyond the specific scope of these individual allegations.

The significance of the findings for these allegations from a procedural perspective is that TUEC's failure to properly address special-case coating systems for overlaps and repairs has resulted in some applied coating systems that are neither qualified nor proven to be technically viable.

b. For allegations concerning procedures and instructions which provide technically incorrect directions:

AQO-07. While the TRT found the disposition and repair for the NCR involved in this particular allegation to be generally acceptable, the TRT found that TUEC's procedures governing application of concrete materials as detailed above, were not in compliance with the manufacturer's instructions. The significance of this finding is that some materials applied at CPSES may not perform adequately in service or under DBA conditions.

AQO-08. The TRT has not substantiated this allegation.

AQO-10. The TRT concludes that TUEC's procedures for power tool cleaning surfaces for touch up work, and inspection of this work, were inadequate to assure acceptable roughening of the surface. The significance of this finding is that some materials applied to these areas may not exhibit adequate adhesion.

AQO-38. The TRT concludes that this allegation is not substantiated.

AQO-39. The TRT concludes that this allegation is not substantiated.

AQO-40. The TRT concludes that TUEC's procedures for removal of debris from power-tool-cleaned surfaces were inadequately rigorous, but unlikely to result in undetected defects in applied coatings. Therefore, this allegation is not significant.

AQO-41. The TRT concludes that the use of the foreign cleaning agent as it occurred at CPSES did not have any adverse effect upon applied coatings, and that current procedures adequately control future use of such materials. Therefore, this allegation is not significant.

AQO-43 and AQO-44. The TRT concludes that the concerns raised by these allegations did not result in improper curing of inorganic zinc at CPSES. Therefore, these allegations are not significant.

c. For allegations concerning backfit inspections:

AQO-51. The TRT has not substantiated this allegation.

AQO-18, AQO-19, and AQO-20. As discussed above, backfit inspection procedures were inadequate in certain respects, however the TRT did not find that these inadequacies would have any significant effect upon the data generated by the backfit program. (See Coatings Category 1.)

d. For allegations concerning coatings applied to areas where they should not have been applied:

The TRT found that the areas described in AQO-24, AQO-42, and AQO-48 have been entered into the CEL and therefore these allegations are not significant. AQO-49 was not substantiated. However, the TRT

found that procedures for protective measures to be taken for items not to be coated were inadequate, resulted in defects which could have been avoided, and created the possibility of unnecessary damage to other plant items. (The TRT did not find evidence that such damage occurred.)

e. For allegations concerning the performance of QC inspections:

AQO-17. The TRT concludes that this allegation is substantiated in regard to the insertion of filters during air acceptance tests, an action which invalidates those test results. The TRT did not find any evidence that this resulted in defects in the work. However, this allegation is significant in that it represents interference with the proper performance of a QC inspection activity and therefore renders recorded results for air acceptance tests, and possibly other inspections, indeterminate.

AQO-23. The TRT concludes that this allegation is not substantiated.

AQO-31. The TRT concludes that this allegation is not substantiated.

AQO-45. The TRT concludes that this allegation is substantiated in regard to inadequate procedural address of reinspection for repair work. The significance of this finding is that there may be undetected and uncorrected defects in repaired areas, although the TRT did not observe any such cases. The TRT found that TUEC's provisions for a final engineering walkdown inspection are not an acceptable remedy for this concern.

AQO-58. The TRT concludes that this allegation is substantiated in regard to inappropriate instructions and requirements for illumination during visual inspections. The significance of this finding is that visual inspections may not have been performed properly; consequently, there may be undetected defects in the applied coatings.

f. For allegations concerning traceability (AQO-34, AQO-36, and AQO-62):

A detailed evaluation of the significance of these allegations is provided in Coatings Category 3. The significance of these concerns in regards to procedures is that inadequately rigorous procedural address of coating material control measures may have resulted in unnecessary loss of traceability.

The significance of the substantiated allegations discussed above, in regards to the TRT's evaluation of TUEC's procedures and instructions governing coating work, is that those procedures were inadequate and inappropriate in many respects. This resulted in defective work in certain instances, which led to an unnecessarily large area of exempt coating work being placed in the CEL. These inadequate procedures also resulted in inadequate performance of inspections in certain instances where proper inspections could have prevented or corrected defective work. The TRT concludes that these procedural deficiencies demonstrate that review and approval of procedures and instructions by TUEC was inadequate to detect

and correct these deficiencies. Inadequate performance of procedures review and approval activities indicates that the personnel who performed those activities may not have been qualified to make the correct technical and quality evaluations of those procedures. These deficiencies, although not of safety significance in the coatings area must be considered in evaluating the effectiveness of the overall QA/QC program.

Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. A summary of the followup interviews is included in Section 2.2.3 of this appendix.

6. Actions Required: The TRT found deficiencies in procedures and instructions for coating work and related inspection activities, during the construction phase, which rendered them inappropriate or inadequate for determining satisfactory accomplishment of important activities. The TRT also found that TUEC's procedure review and approval system was inadequate to detect and correct these deficiencies.

   Accordingly, TUEC shall make the necessary changes to the procedure review and approval system to assure review and approval by technically qualified individuals to prevent recurrence of the types of deficiencies discussed above, and to assure procedures are reviewed for consistency and clarity. This revised review and approval system shall be applied for the issuance and revision of all procedures which will govern future coating work, inspection, and testing at CPSES consistent with the guidelines of Appendix L.

1. Allegation Category: Protective Coatings 5a, Inspection Reports

2. Allegation Number: Parts of AQO-14, AQO-25, AQO-49, AQO-50, AQO-52, AQO-53, AQO-57 and AQO-59

3. Characterization: It is alleged that:

   - Inspection Reports (IRs) can be dispositioned by anyone (AQO-14b).
   - Instead of writing NCRs, IRs must be written as unsatisfactory (AQO-14b).
   - Nothing prevents items identified on unsatisfactory IRs from becoming lost, and the problem is not being resolved (AQO-14b).
   - A seal coat was accepted by QC personnel prior to the finish coat being applied when the seal coat should have been rejected (AQO-25).
   - Coating material is oversprayed into areas that were previously inspected, a practice that is allowed, and is commonplace (AQO-49).
   - Coatings have been applied without the benefit of quality control inspection (AQO-50 and -52).
   - QC inspectors were denied the opportunity to write requests for information or clarification (RFIC) (AQO-53).
   - Coatings were applied over filth (AQO-57).
   - Substandard coatings were accepted by QC inspectors (AQO-59).

4. Assessment of Safety Significance: To address the allegations concerning disposition of IRs for protective coatings, the NRC Technical Review Team (TRT) conducted an examination of the IR system in this area. The TRT reviewed Texas Utilities Generating Company (TUGCO) Procedure CP-QP-18.0, which indicates that IRs are the primary method used to document satisfactory and unsatisfactory coating inspections. The TRT examination of many IRs shows that coating problems usually occur during onsite applications and inspection, a time when repairs can easily be identified, documented, and made through the existing IR system. Based on its review of IRs, the TRT found that IRs which document problems that cannot be corrected using standard repair procedures are then documented by a nonconformance report (NCR). Accordingly, as discussed under AQO-14b, the TRT finds the existing IR system and its implementation to be satisfactory.

   Improper Use of IRs (AQO-14b). In assessing the allegations that comprise AQO-14, the TRT interviewed Coatings QC personnel and found that they avoided writing NCRs because of Procedure QI-QP-11.4-5, Revision 22. Paragraph 3.9 of this revision states: "Nonconforming conditions shall be reported on an IR in accordance with CP-QP-18.0." TUGCO Procedure CP-QP-18.0, Revision 12, July 19, 1983, lists three methods by which IRs are closed: (1) all items are satisfactory; (2) all unsatisfactory items have been repaired and reinspected and found satisfactory; or (3) an NCR has been issued for unsatisfactory items.

The TRT reviewed QI-QP-11.4-5, Revision 22, which was in effect during the period of the allegations, and found that Paragraph 3.9 was not understood by some Coatings QC inspectors. However, QI-QP-11.4-5 referenced CP-QP-18.0, Revision 12, which in the opinion of the TRT PC Group contained adequate methods for closing an IR. Revision 29 of QI-QP-11.4-5 clarifies when NCRs should be prepared. Discussions with Coatings QC inspectors on the current revision of QI-QP-11.4-5 (Revision 29) indicate that they are satisfied with this revision and understand it. TRT interviews with the QC inspectors indicated that even with the old revision of QI-QP-11.4-5, QC did not ignore nonconforming conditions. Review of site procedures by the TRT indicated that IRs cannot be dispositioned "by anyone," as alleged. The only difference between Revision 12 and Revision 20 (the current revision was issued in September 1984) of CP-QP-18.0 is that Revision 20 specifies that a DCA may also be issued which makes the unsatisfactory condition acceptable.

The TRT reviewed the Texas Utilities Electric Company (TUEC) Paper Flow Group (PFG) system which issues protective coating inspection report (PCR) numbers and tracks all incomplete work packages. This system was initiated January 1, 1984. The PFG collected all unsatisfactory IRs prior to January 1984, and developed work packages which documented all coating work, including repairs in a given plant area. The TRT performed a sample review of approximately 100 unsatisfactory IRs issued between December 1, 1982 and January 1, 1984, by which time most coating work except for repairs was completed in Unit 1. The TRT found that these unsatisfactory IRs had been or were being properly processed and tracked. Work packages and IRs were updated on a daily basis by entering deficient, discrepant, and completed work packages on a computer list. The implementation of the PFG system and protective coatings work packages prevented items identified on an IR from becoming lost, and therefore not corrected. The PFG system appears to work effectively for the protective coatings area.

Unacceptable Seal Coat (AQO-25). Allegation AQO-25 concerned a seal coat on the liner plate in Unit 1 outside the Skimmer Pump Room being accepted when it should have been rejected. The alleger states that stains on the liner were, in his opinion, "unacceptable per procedure."

TRT interviewed the QC supervisor involved who indicated that the stains were acceptable by Procedure QI-QP-11.4-26, Revision 6. He stated that the liner was wiped with solvent and water, that the QC inspector involved appeared to be satisfied with the work, and that no pressure was placed on the QC inspector for him to accept the work as done. Review of the related IRs by the TRT confirms that the inspector did, in fact, sign the IR as satisfactory. The TRT could not verify that the QC inspector was coerced.

The TRT determined that stains on organic coatings not removed with water and solvent wiping are acceptable. A TRT observation of the area indicated that it had been topcoated and accepted.

Overspray (AQO-49). Allegation AQO-49 involves alleged overspray into areas that had previously been inspected, which allegedly was allowed and was commonplace.

The TRT review of coating procedures for concrete and structural steel found that overspray/dry spray were adequately addressed in the procedure

revisions made before, during, and after the timeframe of the allegations. The TRT then randomly interviewed coatings QA/QC inspectors, each of whom stated that when overspray was encountered, it was corrected in accordance with applicable QC procedures.

Excessive overspray of primer, if not corrected, can cause adhesion problems when a final coat is applied; however, the TRT review of QC and construction procedures (QI-QP-11.4-5, 4-10, 4-27, and AS-31) indicated that overspray for primer was supposed to be removed, while a minor amount of overspray was acceptable for the final coat. Small amounts of final or topcoat overspray pose no adhesion problems. It is not uncommon for overspray to occur on adjacent areas during spray applications, and CPSES coating procedures and practices adequately addressed this issue.

Coatings Applied Without QC Inspection (AQO-50 and AQO-52). Allegations AQO-50 and AQO-52 address protective coatings applied without the benefit of QC inspections.

The TRT reviewed several NCRs and found documented instances in which coatings had been applied without appropriate QC inspection. However, the alleger gave only general locations affected by this allegation, such as a hanger located on the steel liner, rather than a specific location. The TRT made four attempts during August 1984, to contact the alleger by telephone for more specific information. Messages were given to a relative and a co-worker of the alleger requesting the alleger to call the TRT collect. The alleger never responded. The TRT attempted to obtain a forwarding address from the post office, but had no success.

The TRT review of NCRs indicated that the existing QC inspection program was working in that it documented and identified nonconformances which had not received QC inspections. All areas identified were reworked or dispositioned in accordance with site procedures. All revisions of procedures CCP-30, CCP-30A, and CCP-40, prior to and following the allegation, specify "hold points" for the craft personnel where an inspection must be performed during in-process application of protective coatings.

Although there have been incidents of coatings being applied without QC inspections, adequate procedural measures were established to minimize their recurrence.

QC Inspectors Denied Opportunity of Writing Requests for Information or Clarification (RFIC) (AQO-53). Allegation AQO-53 alleges that QC inspectors were not permitted to write RFICs. The TRT review of this allegation indicates that for a short period of time (2 to 3 months in mid-1982) a former protective coatings QC supervisor orally instructed QC inspectors not to write RFICs. This instruction was subsequently rescinded by QA/QC management. TRT interviews with present QC inspectors indicate that they have not been denied the opportunity to write RFICs nor been told not to write them. Review of many RFICs by the TRT indicates that QC inspectors are writing RFICs. RFICs are written by QC inspectors to request clarification of a procedure or specification or to answer a question the inspector may have on an item. Neither the RFIC nor the response to it are procedurally mandated.

The TRT found that the allegation was substantiated. However, there are no procedural requirements for RFICs; therefore not writing them does not violate any requirement.

Coatings Applied Over Filth (AQO-57). Allegation AQO-57 alleges that at the 860-ft elevation of Unit 2, in the room directly off the elevator, coating was applied to surfaces which were covered with filth, weld spatter, tobacco juice, and other unsuitable material.

The specific area was in Room 163, rod position indication (RPI), elevation 860, Unit 2 Reactor Building, a location documented by NCR-C84-0812 and PC 45291 and attachments. These documents refer to coating being applied to an adjacent area in this room where surface preparation or cleaning had not yet been done. The TRT located the room in question and observed that repair work was in progress on the unacceptable area.

The allegation is substantiated; however, proper documentation exists, and proper disposition of the problem was made.

Acceptance of Substandard Coatings (AQO-59). Allegation AQO-59 alleges that QC inspectors accepted substandard coating on the liner plate below and above the polar crane rail at azimuth 270° to 0° in the Unit 1 Containment Building. The TRT examined all protective coating (PC) inspection reports related to the area from azimuth 270° to 0° between the 905-foot and 940-foot elevations on the containment steel liner plate. The review indicated that many IRs noted unsatisfactory conditions, which were later corrected. None of the inspection reports indicated that QC inspectors accepted substandard coatings.

Only one QC inspector involved in writing these IRs was still working at Comanche Peak. The TRT interviewed the remaining QC inspector, but he gave no indication that QC inspectors had accepted substandard work. The TRT also interviewed nine current on-the-job QC inspectors at CPSES, all of whom stated that QC inspectors do not accept substandard work.

5. Conclusion and Staff Positions: Based on the TRT review of the TUEC inspection report system and their implementation of it, as well as on the TRT investigation of alleged improper use of IRs, unacceptable seal coat, overspray, coatings applied without QC inspections, coatings applied over filth, and acceptance of substandard coatings, the TRT concludes that reviews of all issues involved indicated in each case that proper documents existed and corrective action was initiated. Allegations AQO-50, -52, -53, and -57 were substantiated, but the proper documentation and appropriate corrective actions were taken. The TRT concludes that these allegations have neither safety significance nor generic implications.

   Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. A summary of the followup interviews is included in Section 2.2.3 of this Appendix.

6. Actions Required: None.

1. Allegation Category: Protective Coatings 5b, Nonconformance Reports

2. Allegation No.: AQO-7 and AQO-14

3. Characterization: It is alleged that: (1) the disposition of nonconformance report (NCR) C83-01986, which dispositions cracking and flaking of concrete coatings will not remedy the problem (AQO-7); (2) after an NCR is written, anyone can sign off on it (AQO-14a); (3) NCRs cannot be written and IRs must be written as "unsatisfactory" (AQO-14b); and, (4) a past QC supervisor voided many NCRs (AQO-14c).

4. Assessment of Safety Significance: To assess the allegations concerning disposition and approval of NCRs for protective coatings, the NRC Technical Review Team (TRT) conducted a generic examination of Texas Utilities Electric Company's (TUEC's) NCR system for coatings.

The procedural definition of a nonconformance is a deficiency in characteristic, documentation, or procedure which renders the quality of an item unacceptable or indeterminate. The TRT reviewed Texas Utilities Generating Company (TUGCO) Procedure CP-QP-16.0, "Nonconformances." This procedure describes the system for identifying, resolving, and closing out nonconformances. The TRT specifically reviewed revisions 8 and 14 of procedure CP-QP-16.0, because they were in effect during the period bracketing the allegations.

To audit TUEC's implementation of the NCR system in the coatings area, the TRT reviewed approximately 30 completed NCRs to determine if their disposition was adequate. The TRT noted that several of these NCRs showed insufficient documented engineering justification. Since these NCRs mainly involved design basis accident (DBA) qualification of coatings or coating traceability, they were assessed in Coatings Categories 2 and 3, which discuss the generic problem that TUEC's NCR system does not specifically require, for significant conditions adverse to quality, identification of the cause of the problem or the necessary corrective action taken to prevent the problem's recurrence.

The TRT also found that NCRs for protective coatings were not trended properly. The present Quality Trend Analysis Reports, which were issued in accordance with TUGCO procedure CP-QP-17.0, "Corrective Action," combine coating NCRs with other civil engineering NCRs. Combining these NCRs in the trending analysis provided a composite trend for protective coatings which was neither representative nor accurate. Therefore, the trending system was inadequate to identify and control recurring deviations or overall increases in deviations for protective coatings.

NCR C83-01986 pertains to the cracking and flaking of concrete coatings systems (Nutec-11, -11S, -1201). Allegation AQO-7 is concerned with the disposition section of this NCR, which states that "cracking of coatings is due to excessive stresses in the coating during drying and curing" and accepts reworking of the affected areas as the proper disposition. The alleger believes that the disposition of this NCR was inadequate, and that repairing these cracks will not remedy the condition which caused the cracks. (This subject is discussed in detail in Coatings Categories 2 and 4 and under AQO-06 and AQO-07.)

The TRT reviewed NCR-C83-01986 and the manufacturer's (Imperial) application bulletin. Both documents indicate that the disposition of the NCR was adequate. During the cure process, chemically converted organic coatings develop internal stresses, due to shrinkage, which may cause cracking and peeling. Proper application will prevent a recurrence of this condition.

The TRT reviewed TUGCO procedures QI-QP-11.4-27 and CCP-40 and verified that the procedural requirements assured proper application and emphasized control of film thickness. The TRT also performed a walkdown inspection of the Unit 1 Containment Building. The TRT found no visual signs of stress cracking and observed that the affected areas apparently had been repaired.

The TRT reviewed TUEC's methods for incorporating vendor coating recommendations and information from vendor application bulletins into their coating procedures. (These findings are reported in Coatings Category 4.)

To assess allegation AQO-14a, the TRT reviewed TUGCO Procedure CP-QP-16.0. This procedure indicates that NCRs are the primary means of documenting nonconforming conditions that cannot be corrected by standard procedural repair or nonconforming conditions which are indeterminate. The TRT reviewed revisions 8 and 14 to CP-QP-16.0, which bracketed the time period of the allegation. These revisions required NCRs to be prepared, reviewed, dispositioned, and signed off by personnel authorized to verify closure of an NCR.

Procedure CP-QP-16.0 states that "QC discipline supervisors shall ensure that the NCR disposition work items are witnessed by QC inspectors." The procedure further states that "QA/QC supervisors shall sign the verification block." TUGCO procedure CP-QP-16.0, "Nonconformances" (Paragraph 3.2.7) also requires necessary approvals for those portions of NCRs that are affected by revisions. However, in reviewing actual NRCs, the TRT found that only the original handwritten copy of an NCR is signed and dated by the QC inspector. On subsequent, typed copies of NCRs, the name of the reporting QC inspector is typed on the NCR and is neither initialed nor dated. The alleger may have been referring to these typed NCRs.

On September 10, 1984, the TRT telephoned the alleger to obtain further information on allegation AQO-14c. The TRT asked the alleger what was meant by the term "voided," i.e., that an NCR was cancelled but remained in the record file, or that it was destroyed and there was no longer a record. The alleger was not certain whether any NCRs were physically destroyed, but believed that the disposition of one NCR was not adequate. Therefore, the alleger considered that NCRs were, in effect, "voided." The alleger had personally prepared only a few (unspecified) NCRs, and was not alleging that "many" NCRs were voided. Only one specific instance (NCR C82-00060) was identified by the alleger. The alleger considered this NCR to have been "voided" because, instead of sandblasting and entirely recoating hangers and shims, the disposition of the NCR permitted localized repair to be made. The alleger believed this disposition of the NCR was contrary to both site procedures and ANSI standards.

The TRT located NCR C82-00060, Revisions 0 and 1, in the site record vault. This NCR involved a deposit of oil-based soot from forced curing heaters on 16 electrical hangers and 51 hanger shims. This deposit had occurred while the final coat was still "tacky." The NCR dispositioned the hangers for rework by requiring that the contaminated areas be wiped with solvent and, if necessary, lightly sanded until the discoloration was removed. After repair, these areas were rechecked for film thickness. Because of the small amount of coated surface which would be exposed after installation of the shims, the shims were dispositioned "use-as-is." The TRT found the dispositioned repair to be technically adequate and consistent both with the site procedures referenced in the NCR and with ANSI standards.

5. Conclusion and Staff Positions: The TRT concludes that these allegations are not substantiated. The overall NCR system is in compliance with TUGCO procedural requirements. However, the TRT noted weaknesses in the Coatings NCR system. These weaknesses are related to insufficient documentation of engineering justifications for those NCRs which involve DBA qualification and coating traceability and to poor trending capability. These concerns are assessed in Coatings Categories 2 and 3.

   Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. A summary of the followup interviews is included in Section 2.2.3 of this Appendix.

6. Actions Required: None.

1. Allegation Category: Protective Coatings 5b, Nonconformance Reports

2. Allegation No.: AQO-7 and AQO-14

3. Characterization: It is alleged that: (1) the disposition of nonconformance report (NCR) C83-01986, which dispositions cracking and flaking of concrete coatings will not remedy the problem (AQO-7); (2) after an NCR is written, anyone can sign off on it (AQO-14a); (3) NCRs cannot be written and IRs must be written as "unsatisfactory" (AQO-14b); and, (4) a past QC supervisor voided many NCRs (AQO-14c).

4. Assessment of Safety Significance: To assess the allegations concerning disposition and approval of NCRs for protective coatings, the NRC Technical Review Team (TRT) conducted a generic examination of Texas Utilities Electric Company's (TUEC's) NCR system for coatings.

The procedural definition of a nonconformance is a deficiency in characteristic, documentation, or procedure which renders the quality of an item unacceptable or indeterminate. The TRT reviewed Texas Utilities Generating Company (TUGCO) Procedure CP-QP-16.0, "Nonconformances." This procedure describes the system for identifying, resolving, and closing out nonconformances. The TRT specifically reviewed revisions 8 and 14 of procedure CP-QP-16.0, because they were in effect during the period bracketing the allegations.

To audit TUEC's implementation of the NCR system in the coatings area, the TRT reviewed approximately 30 completed NCRs to determine if their disposition was adequate. The TRT noted that several of these NCRs showed insufficient documented engineering justification. Since these NCRs mainly involved design basis accident (DBA) qualification of coatings or coating traceability, they were assessed in Coatings Categories 2 and 3, which discuss the generic problem that TUEC's NCR system does not specifically require, for significant conditions adverse to quality, identification of the cause of the problem or the necessary corrective action taken to prevent the problem's recurrence.

The TRT also found that NCRs for protective coatings were not trended properly. The present Quality Trend Analysis Reports, which were issued in accordance with TUGCO procedure CP-QP-17.0, "Corrective Action," combine coating NCRs with other civil engineering NCRs. Combining these NCRs in the trending analysis provided a composite trend for protective coatings which was neither representative nor accurate. Therefore, the trending system was inadequate to identify and control recurring deviations or overall increases in deviations for protective coatings.

NCR C83-01986 pertains to the cracking and flaking of concrete coatings systems (Nutec-11, -11S, -1201). Allegation AQO-7 is concerned with the disposition section of this NCR, which states that "cracking of coatings is due to excessive stresses in the coating during drying and curing" and accepts reworking of the affected areas as the proper disposition. The alleger believes that the disposition of this NCR was inadequate, and that repairing these cracks will not remedy the condition which caused the cracks. (This subject is discussed in detail in Coatings Categories 2 and 4 and under AQO-06 and AQO-07.)

the issuance of Revision 1, TUEC has listed the unacceptable areas where a 0.5-mil-thick coating of primer was applied in the coatings exempt log (CEL) as Items 8-18.

Protective Q Coatings Placed Over Rusty, Scaly, Unprepared Metal Surfaces (AQO-24). The allegation is that Q coatings (that is, coatings in safety-related areas) have been placed over rusty, scaly, unprepared metal surfaces inside pipe supports made of tube steel which have no end-caps. In these cases, the protective coating gets on the rust inside of the tube. The concern is that this coating material could later crack, scale, come off the inside of the pipe, and then travel to the sumps.

The TRT walked through the Unit 1 Containment Building and observed that the structural tube steel supports have protective coatings applied from 0 inches to approximately 3½ inches inside the tubing. Most of the areas observed appeared to be coated with a fine mist, apparently from overspray inside the steel tube. The areas in question are very small, and in many cases there is no coating inside the tube steel. It was obvious to the TRT that these areas would be very difficult to clean and prepare for coating. Moreover, there is no regulatory requirement nor TUEC procedural requirement that end-caps be placed on tube steel.

The TRT verified that TUEC entered 6,000 square feet of surface in the CEL, which the TRT believes is a conservative estimate, as this amount is only 1 percent of the total coated surface.

DCAs Not Controlled (AQO-26). The allegation is that DCA documents are not controlled. A TRT review of this allegation indicates that procedures CP-EP-4.6, CP-EP-4.7, and DCP-3 control field design changes, such as DCAs. Comanche Peak Project Engineering (CPPE) initiates the DCA through procedure CP-EP-4.6. The original copy is sent to the Automated Records Management System (ARMS), which is a part of the Document Control Center (DCC). DCC receives DCAs, logs them, and issues them control numbers. Controlled DCAs for coatings were issued from document satellite stations in the field. These stations assured that craft personnel maintained current revisions to all design changes.

The TRT learned that, prior to April 1984, the TUEC coatings QA/QC group had a control box at DCC into which all DCAs affecting coatings were placed. These were controlled copies. The TRT discussion with a certified file clerk for the coatings QA/QC group indicated that the clerk collected all DCAs from the coatings control box at DCC and attached them to the coatings specifications in the field. The clerk was also responsible for making the QC supervisor aware of each DCA. The supervisor was then responsible for informing QC inspectors of the DCAs.

Procedure DCP-3 describes the document control activities at CPSES. Comanche Peak Project Engineering (CPPE) forwarded information copies to the various disciplines designated on a standard distribution list, such as Quality Engineering and Civil Engineering. These copies were not controlled; however, they were not used for construction and inspection. The TRT determined, therefore, that the DCAs at CPSES were controlled procedurally.

1. Allegation Category: Protective Coatings 5b, Nonconformance Reports

2. Allegation No.: AQO-7 and AQO-14

3. Characterization: It is alleged that: (1) the disposition of nonconformance report (NCR) C83-01986, which dispositions cracking and flaking of concrete coatings will not remedy the problem (AQO-7); (2) after an NCR is written, anyone can sign off on it (AQO-14a); (3) NCRs cannot be written and IRs must be written as "unsatisfactory" (AQO-14b); and, (4) a past QC supervisor voided many NCRs (AQO-14c).

4. Assessment of Safety Significance: To assess the allegations concerning disposition and approval of NCRs for protective coatings, the NRC Technical Review Team (TRT) conducted a generic examination of Texas Utilities Electric Company's (TUEC's) NCR system for coatings.

The procedural definition of a nonconformance is a deficiency in characteristic, documentation, or procedure which renders the quality of an item unacceptable or indeterminate. The TRT reviewed Texas Utilities Generating Company (TUGCO) Procedure CP-QP-16.0, "Nonconformances." This procedure describes the system for identifying, resolving, and closing out nonconformances. The TRT specifically reviewed revisions 8 and 14 of procedure CP-QP-16.0, because they were in effect during the period bracketing the allegations.

To audit TUEC's implementation of the NCR system in the coatings area, the TRT reviewed approximately 30 completed NCRs to determine if their disposition was adequate. The TRT noted that several of these NCRs showed insufficient documented engineering justification. Since these NCRs mainly involved design basis accident (DBA) qualification of coatings or coating traceability, they were assessed in Coatings Categories 2 and 3, which discuss the generic problem that TUEC's NCR system does not specifically require, for significant conditions adverse to quality, identification of the cause of the problem or the necessary corrective action taken to prevent the problem's recurrence.

The TRT also found that NCRs for protective coatings were not trended properly. The present Quality Trend Analysis Reports, which were issued in accordance with TUGCO procedure CP-QP-17.0, "Corrective Action," combine coating NCRs with other civil engineering NCRs. Combining these NCRs in the trending analysis provided a composite trend for protective coatings which was neither representative nor accurate. Therefore, the trending system was inadequate to identify and control recurring deviations or overall increases in deviations for protective coatings.

NCR C83-01986 pertains to the cracking and flaking of concrete coatings systems (Nutec-11, -11S, -1201). Allegation AQO-7 is concerned with the disposition section of this NCR, which states that "cracking of coatings is due to excessive stresses in the coating during drying and curing" and accepts reworking of the affected areas as the proper disposition. The alleger believes that the disposition of this NCR was inadequate, and that repairing these cracks will not remedy the condition which caused the cracks. (This subject is discussed in detail in Coatings Categories 2 and 4 and under AQO-06 and AQO-07.)

The TRT reviewed NCR-C83-01986 and the manufacturer's (Imperial) application bulletin. Both documents indicate that the disposition of the NCR was adequate. During the cure process, chemically converted organic coatings develop internal stresses, due to shrinkage, which may cause cracking and peeling. Proper application will prevent a recurrence of this condition.

The TRT reviewed TUGCO procedures QI-QP-11.4-27 and CCP-40 and verified that the procedural requirements assured proper application and emphasized control of film thickness. The TRT also performed a walkdown inspection of the Unit 1 Containment Building. The TRT found no visual signs of stress cracking and observed that the affected areas apparently had been repaired.

The TRT reviewed TUEC's methods for incorporating vendor coating recommendations and information from vendor application bulletins into their coating procedures. (These findings are reported in Coatings Category 4.)

To assess allegation AQO-14a, the TRT reviewed TUGCO Procedure CP-QP-16.0. This procedure indicates that NCRs are the primary means of documenting nonconforming conditions that cannot be corrected by standard procedural repair or nonconforming conditions which are indeterminate. The TRT reviewed revisions 8 and 14 to CP-QP-16.0, which bracketed the time period of the allegation. These revisions required NCRs to be prepared, reviewed, dispositioned, and signed off by personnel authorized to verify closure of an NCR.

Procedure CP-QP-16.0 states that "QC discipline supervisors shall ensure that the NCR disposition work items are witnessed by QC inspectors." The procedure further states that "QA/QC supervisors shall sign the verification block." TUGCO procedure CP-QP-16.0, "Nonconformances" (Paragraph 3.2.7) also requires necessary approvals for those portions of NCRs that are affected by revisions. However, in reviewing actual NRCs, the TRT found that only the original handwritten copy of an NCR is signed and dated by the QC inspector. On subsequent, typed copies of NCRs, the name of the reporting QC inspector is typed on the NCR and is neither initialed nor dated. The alleger may have been referring to these typed NCRs.

On September 10, 1984, the TRT telephoned the alleger to obtain further information on allegation AQO-14c. The TRT asked the alleger what was meant by the term "voided," i.e., that an NCR was cancelled but remained in the record file, or that it was destroyed and there was no longer a record. The alleger was not certain whether any NCRs were physically destroyed, but believed that the disposition of one NCR was not adequate. Therefore, the alleger considered that NCRs were, in effect, "voided." The alleger had personally prepared only a few (unspecified) NCRs, and was not alleging that "many" NCRs were voided. Only one specific instance (NCR C82-00060) was identified by the alleger. The alleger considered this NCR to have been "voided" because, instead of sandblasting and entirely recoating hangers and shims, the disposition of the NCR permitted localized repair to be made. The alleger believed this disposition of the NCR was contrary to both site procedures and ANSI standards.

The TRT located NCR C82-00060, Revisions 0 and 1, in the site record vault. This NCR involved a deposit of oil-based soot from forced curing heaters on 16 electrical hangers and 51 hanger shims. This deposit had occurred while the final coat was still "tacky." The NCR dispositioned the hangers for rework by requiring that the contaminated areas be wiped with solvent and, if necessary, lightly sanded until the discoloration was removed. After repair, these areas were rechecked for film thickness. Because of the small amount of coated surface which would be exposed after installation of the shims, the shims were dispositioned "use-as-is." The TRT found the dispositioned repair to be technically adequate and consistent both with the site procedures referenced in the NCR and with ANSI standards.

5. Conclusion and Staff Positions: The TRT concludes that these allegations are not substantiated. The overall NCR system is in compliance with TUGCO procedural requirements. However, the TRT noted weaknesses in the Coatings NCR system. These weaknesses are related to insufficient documentation of engineering justifications for those NCRs which involve DBA qualification and coating traceability and to poor trending capability. These concerns are assessed in Coatings Categories 2 and 3.

   Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. A summary of the followup interviews is included in Section 2.2.3 of this Appendix.

6. Actions Required: None.

1. Allegation Category: Protective Coatings 5c, Design Change Authorizations

2. Allegation Number: AQO-11, AQO-24, AQO-26 AQO-27, AQO-28, AQO-29, AQO-30 and AQO-31

3. Characterization: It is alleged that:

   - A design change authorization (DCA) allows primer coat of 0.5 mils without design basis accident (DBA) qualification (AQO-11).
   - Protective coatings are placed over rusty, scaly, unprepared metal surfaces inside pipe supports (AQO-24).
   - DCAs are not controlled (AQO-26).
   - DCAs are originated by Engineering without QA/QC input (AQO-27).
   - DCAs are written instead of NCRs (AQO-28).
   - DCAs are written to overcome problems (AQO-29).
   - DCAs are used to downgrade surface preparation and specification AS-31 (AQO-30 and AQO-31).

4. Assessment of Safety Significance: In assessing these allegations, the NRC Technical Review Team (TRT) reviewed the DCA system for coatings generically, as described in site procedure CP-EP-4.0 and 4.6, "Design Control and Field Design Change Control," and discussed the DCA system with the Texas Utilities Electric Company (TUEC) Nuclear Engineering Group (TNE). The TRT found that the DCA system is complex. DCAs are generated when the need for immediate changes, critical to construction, arise. The changes are authorized by specified engineering personnel following a two-stage process. In the first stage, an authorized person reviews and approves a DCA onsite. (This authorized person may or may not be a Gibbs & Hill [G&H] engineer.) In the second stage, the G&H Architect Engineer performs a final review of the design change and approves it. At this stage, the DCA system is in compliance with ANSI N45.2.11.

   The TUEC Design Change Tracking Group (DCTG) tracks and logs all DCAs. Procedure CP-EP-4.7, Rev. 10, describes the responsibilities of the DCTG. The TRT found that the DCA system described in the site procedures complies with ANSI N45.2.11-1974, Section 4, "Design Process." However, the TRT observed failures to fully implement the procedural system in changes to protective coating requirements which affected DBA qualification of coatings. (For further details of these problems, refer to DBA Qualification Tests, Coatings Category 2.)

   DCA Allows Primer Coat of 0.5 Mils Without DBA Qualification (AQO-11). The allegation is that DCA 18,489 allows a primer thickness of 0.5 mils. The alleger is questioning whether this thickness of primer has been DBA qualified in accordance with ANSI 101.2-1972.

   The TRT review of DCA 18,489 Revisions 0 and 1, indicated that TUEC is aware that this 0.5-mil primer thickness has not been DBA qualified. Although Revision 0 of the DCA accepted the 0.5-mil primer thickness, with

the issuance of Revision 1, TUEC has listed the unacceptable areas where a 0.5-mil-thick coating of primer was applied in the coatings exempt log (CEL) as Items 8-18.

Protective Q Coatings Placed Over Rusty, Scaly, Unprepared Metal Surfaces (AQO-24). The allegation is that Q coatings (that is, coatings in safety-related areas) have been placed over rusty, scaly, unprepared metal surfaces inside pipe supports made of tube steel which have no end-caps. In these cases, the protective coating gets on the rust inside of the tube. The concern is that this coating material could later crack, scale, come off the inside of the pipe, and then travel to the sumps.

The TRT walked through the Unit 1 Containment Building and observed that the structural tube steel supports have protective coatings applied from 0 inches to approximately 3½ inches inside the tubing. Most of the areas observed appeared to be coated with a fine mist, apparently from overspray inside the steel tube. The areas in question are very small, and in many cases there is no coating inside the tube steel. It was obvious to the TRT that these areas would be very difficult to clean and prepare for coating. Moreover, there is no regulatory requirement nor TUEC procedural requirement that end-caps be placed on tube steel.

The TRT verified that TUEC entered 6,000 square feet of surface in the CEL, which the TRT believes is a conservative estimate, as this amount is only 1 percent of the total coated surface.

DCAs Not Controlled (AQO-26). The allegation is that DCA documents are not controlled. A TRT review of this allegation indicates that procedures CP-EP-4.6, CP-EP-4.7, and DCP-3 control field design changes, such as DCAs. Comanche Peak Project Engineering (CPPE) initiates the DCA through procedure CP-EP-4.6. The original copy is sent to the Automated Records Management System (ARMS), which is a part of the Document Control Center (DCC). DCC receives DCAs, logs them, and issues them control numbers. Controlled DCAs for coatings were issued from document satellite stations in the field. These stations assured that craft personnel maintained current revisions to all design changes.

The TRT learned that, prior to April 1984, the TUEC coatings QA/QC group had a control box at DCC into which all DCAs affecting coatings were placed. These were controlled copies. The TRT discussion with a certified file clerk for the coatings QA/QC group indicated that the clerk collected all DCAs from the coatings control box at DCC and attached them to the coatings specifications in the field. The clerk was also responsible for making the QC supervisor aware of each DCA. The supervisor was then responsible for informing QC inspectors of the DCAs.

Procedure DCP-3 describes the document control activities at CPSES. Comanche Peak Project Engineering (CPPE) forwarded information copies to the various disciplines designated on a standard distribution list, such as Quality Engineering and Civil Engineering. These copies were not controlled; however, they were not used for construction and inspection. The TRT determined, therefore, that the DCAs at CPSES were controlled procedurally.

TRT document reviews and discussions with QA/QC personnel concerning this allegation indicated that prior to current procedural revisions and unwritten practices (such as QA/QC group meetings), QC inspectors did not receive all DCAs. Although the QA distribution list for DCAs has always existed, the TRT learned in discussions with QA personnel that someone in QA decided whether or not the QC inspectors needed to receive a specific DCA. QA personnel told the TRT that if a DCA did not affect the procedures or quality, many times QC inspectors would not receive it. The TRT was told, for example, that many of these DCAs concerned coatings in inaccessible areas being placed in the CEL. The TRT found this to be the case in its examination of these DCAs.

If DCAs which relax coating requirements are not distributed to QC inspectors, their inspections could be in the conservative direction. The TRT found that none of the DCAs they examined made inspection requirements more stringent.

DCAs Originated by Engineering; QA/QC Has No Input (AQO-27). The allegation is that DCAs at CPSES are originated and totally approved by Engineering and that QA/QC has no input in the review and disposition of DCAs.

The TRT review of the present program indicated that QA/QC has no procedural requirements for input in the review of DCAs generated by Engineering; however, QA/QC is on the distribution list for DCAs. Coating QA Engineers (QE) receive all DCAs related to coatings. The TRT's observations and discussions with Quality Engineering, Engineering, and QC personnel indicated that all disciplines are aware of a DCA before it reaches the place or activity affected. The TRT review also indicated that it is an unwritten policy that Engineering personnel frequently discuss proposed DCAs with Quality Engineering before they are issued. QE then indicates concerns, which result from the review with Engineering, for resolution.

There is no regulatory requirement that Quality Assurance must review or approve design changes. Criterion III, Appendix b, of 10 CFR 50 does require design changes to be reviewed by the original design organization. The TRT determined that the present method for controlling DCAs at CPSES violates no procedure, nor is there a requirement that commits TUEC to have QA/QC provide input to DCAs. The present system appears to be working in that QA/QC personnel do contribute to most decisions made concerning DCAs.

DCAs Are Written Instead of NCRs (AQO-28). This allegation is that DCAs are used "frequently and conveniently" to cover up a condition for which a nonconformance report (NCR) should be written. The alleger estimated that 40% of the DCAs were for NCR conditions.

The TRT randomly sampled 70 DCAs attached to specification AS-31, the majority of which were originated for clarification purposes or regarding conditions in inaccessible areas. NCRs are to be originated when a deficiency renders the quality of an item unacceptable or indeterminate. Of the 70 DCAs reviewed, 5 appeared to indicate an NCR condition. It is the TRT opinion that these DCAs indicated indeterminate quality and should have been addressed in NCRs. (AQO-11 discussed earlier is an example of this condition.) The time span between the five DCAs indicated to the TRT that DCAs were not frequently used for NCR conditions; thus, it appears

that these DCAs were isolated cases. The TRT review of the descriptions and resolutions of the five DCAs did not indicate any technical concerns regarding the quality of coatings.

The TRT determined that DCAs were used as a tool to resolve problems in a timely fashion as they arose and that a few DCAs were written for conditions that should have required an NCR. However, the TRT did not find that DCAs were used "frequently and conveniently" to cover up problems or that 40 percent of the DCAs written were for NCR conditions.

DCAs Are Written to Overcome Problems (AQO-29). The allegation is that DCAs were written to overcome a problem which would take considerable time to repair. In other words, DCAs were used to facilitate the completion of a job even though it meant that accepted QA/QC site procedures would not be followed.

The TRT review of this allegation indicates that DCAs were generated when changes critical to construction arose. An example would be DCA 16,106, Rev. 1. (Refer to allegation AQO-24 in this category.) The TRT noted that it is acceptable industry practice to modify specification requirements if they cannot be satisfied for one reason or another, provided that basic design criteria are met and safety is not impaired.

Downgrading of Surface Preparation (AQO-30 and AQO-31). Allegation AQO-30 is that, on numerous occasions, DCAs were issued to downgrade the surface preparation from an SP-10 to an SP-6 standard preparation; DCAs were written to downgrade specification AS-31 requirements in the Containment Building to AS-30, which is the nonsafety specification. AQO-31 alleged that QC management interpreted an SP-6 on a DCA to mean "do the best you can"; when difficult access areas were involved, QC management allegedly stated to QC inspectors, "if you cannot get to an area do not worry about it."

The majority of DCAs reviewed by the TRT applied to inaccessible areas. The TRT review of DCAs for allegation AQO-30 indicated that from time to time Engineering did change or downgrade surface preparation from SP-10 to SP-6.

Allegation AQO-31 is similar to AQO-30. The TRT review and discussions with QA/QC personnel did not substantiate the allegation that QC management stated to QC inspectors: "if you cannot get to an area do not worry about it." QC inspectors did have questions about DCA 13,140, Revision 1, involving which areas were considered to be inaccessible and what should be QC inspected. DCA 13,140, Revision 2, clarified this issue by including definitive criteria for determining whether an area was to be considered inaccessible.

The TRT determined that downgrading specification requirements for inaccessible areas to a "best-effort," or "use-as-is" standard is accepted industry practice. The TRT review of the CEL indicated that virtually all of the inaccessible areas documented by DCAs had been placed in the exempt log. The TRT also determined that, based on exempt log estimates, the total area downgraded is not over 3 percent of the total coated surface.

5. Conclusion and Staff Positions: The TRT concludes that all of the allegations reviewed were substantiated. These deficiencies, although not of safety significance in the coatings area, must be considered in evaluating the effectiveness of TUEC's overall QA/QC program.

   Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. A summary of the followup interviews is included in Section 2.2.3 of this Appendix.

6. Actions Required: None.

1. Allegation Category: Protective Coatings 6, Coatings Exempt Log (CEL)

2. Allegation Numbers: None specifically for the CEL.

3. Characterization: In its assessment of allegations concerning deficiencies in protective coatings work, the NRC Technical Review Team (TRT) found that the number and area of the coated items entered into the CEL was a convenient measure of plant coatings with unacceptable or indeterminate quality. The TRT also found that many items described in the protective coatings allegations were entered into the CEL, and that the area entered in the CEL was a significant fraction of the total area coated. The TRT, therefore, conducted a generic review of the operation of the CEL.

4. Assessment of Safety Significance: The NRC staff has concurred (see Appendix L) with a study by Texas Utilities Electric Company (TUEC) indicating that failure of the coatings inside the Containment Building would not unacceptably degrade the performance of post-accident fluid systems. Thus, qualification is not required for coatings at CPSES, and deficiencies which might result in coating failure do not have safety significance. As a result, the quantity of coatings represented in the CEL also does not have direct safety significance.

However, based on TUEC's prior Final Safety Analysis Report (FSAR) commitment to provide qualified coatings inside the Containment Building, coatings applied before issuance of Appendix L were required to have been applied as qualified coatings. TUEC's failure to fulfill that prior commitment, as described in this Appendix, indicates deficiencies in the Coatings QA/QC program. These deficiencies, although not of safety significance in the coatings area must be considered in evaluating the effectiveness of TUEC's overall QA/QC program.

The CEL was established by TUEC Procedure CP-EP-16.4, "Protective Coatings Exemption Log," to "provide the method for maintaining identification of items and/or areas that do not meet project coating requirements." In conducting its review, the TRT examined this procedure, interviewed several TUEC civil engineering and QA personnel regarding CEL operation and examined a number of documents by which some of the larger areas (1000 square feet or greater) were placed in the log. These documents included TUEC memorandum QTQ-416; design change authorization (DCA) 17, 142; nonconformance report (NCR) C-84-00710; DCA 6114, Rev. 1; DCA 12,374, Rev. 1; DCA 16,106; and NCR C-84-01488, Rev. 4.

The TRT found several deficiencies in TUEC Procedure CP-EP-16.4. Although it places responsibility for approving items to be included in the CEL with a civil engineer or his representative, it provides no specific direction or criteria to assure that items not meeting project coating requirements and not scheduled for repair or rework are systematically entered into the CEL. Nor does the procedure require each CEL entry to be signed and dated by the civil engineering representative, to identify the document describing the coating deficiency, or to describe the basis for placing the item in the log.

The TRT examined the documents (NCRs and DCAs) by which some of the larger items were entered into the CEL, which was provided to the TRT by TUEC

letter of August 10, 1984. Also, the TRT examined the method by which the areas designated for the log were estimated. The TRT found that determinations to place items in the CEL were made in a conservative manner and the methods for estimating the areas involved were reasonably conservative.

In the course of its review of the backfit test program and other aspects of the protective coatings, the TRT found a number of items that should have been included in the CEL, but were not. The largest of these were the areas of miscellaneous steel and concrete and containment liner which failed the coating backfit test program adhesion tests after the original data were corrected for the Elcometer calibration error. This total area may be as large as 57,500 square feet. Approximately 3000 square feet have already been entered into the CEL because of failed adhesion tests; the remaining 54,500 square feet should be added to the CEL. (See Coatings Category 1.)

A second item not included in the CEL involved coated areas with deficiencies other than poor adhesion. For example, a number of NCRs relating to unsatisfactory dry film thickness (DFT) (C-83-03103, Rev. 2; C-83-03104, Rev. 2; and C-83-3105, Rev. 2) direct that all miscellaneous steel items with unsatisfactory DFTs be "used-as-is" and entered into the CEL. As a conservative estimate of the area involved, TUEC used 5 percent of the total surface area of each category of miscellaneous steel for a total of 8,150 square feet. This estimate may be low because the DFT test failure rate before cosmetic rework averaged 8.5 percent for the miscellaneous steel categories. Also, according to interviews between the TRT and TUEC QA personnel, a number of discrepant areas were still not finally dispositioned by either rework or entry into the CEL.

A third item which has not been included in the CEL involves non-standard coatings which were not DBA qualified. (See Coatings Category 2.) One example is inorganic zinc coatings applied over organic topcoat in the overlap areas that surround repairs to protective coatings over steel. By letter of August 21, 1984, to NRC, TUEC estimated this overlap area to be between 2,500 and 6,500 square feet.

Available documents do not indicate whether the 6,100 square feet of inaccessible or limited-access areas described in TUEC's letter TXX-4262 to NRC of August 21, 1984, in relation to allegation AQO-31 were entered into the CEL. DCA 13140, Rev. 2, downgrades the requirements for these areas, but does not specify that the areas should be placed in the CEL.

5. Conclusion: The TRT concludes that the operation of the CEL system was deficient in several respects. TUEC Procedure CP-EP-16.4 did not provide adequate guidance and direction to assure that areas with coatings of unacceptable or indeterminate quality were either reworked or entered into the CEL.

The TRT further concludes that several sizable areas with coatings of indeterminate quality have not been included in the CEL. These areas include 54,500 square feet, which may have failed the adhesion test according to the TRT audit of the BTP, and 2,500 to 6,500 square feet of non-standard coatings which were not DBA qualified. Therefore, approximately

60,000 square feet of area of indeterminate quality should be added to the CEL.

Without including this additional 60,000 square feet, the CEL identified approximately 55,000 square feet of unqualified or indeterminate coatings. This 55,000-square-foot value is already considered high by the TRT, and it would be more than doubled by including the additional 60,000 square feet. The total of 115,000 square feet is approximately 20 percent of the total coated area in the Unit 1 Containment Building. The TRT finds that this value is excessive when compared to CEL areas reported by other applicants.

The implication of the 20 percent CEL value is that the remaining 80 percent of the coatings are of satisfactory quality. However, such an implication cannot be considered valid until the resolution of other TRT concerns, such as assurance of DBA qualification of coatings and their traceability, is reached. (See Coatings Categories 2 and 3.)

6. Actions Required: TUEC shall provide updated estimates of the additional items, including those detailed above, to be entered into the exempt log. Although all coatings are now considered not safety related, the CEL shall still be maintained to separately identify all items which did not meet the requirements in effect at the time the coating work was performed. This log will be used in planning future inspections of coatings consistent with the guidelines of Appendix L.

1. Allegation Category: Protective Coatings 7, Training and Qualification of Coatings Inspectors and Painters

2. Allegation Numbers: AQO-22, AQO-32, AQO-33, AQO-35, and AQO-61

3. Characterization: It is alleged that:

   - Coatings inspectors must perform backfit test program adhesion testing without first completing training (AQO-22).

   - Reading list contents have been changed after inspectors sign the list (AQO-32).

   - A lead coatings inspector lacked the qualifications to properly perform his duties (AQO-33).

   - Some persons providing training to prospective inspectors are not properly qualified (AQO-61a).

   - Level II inspectors "sign-off" for training conducted by Level I inspectors (AQO-61b).

   - Management was aware that some inspectors were trained by unqualified instructors and took no corrective action (AQO-61c).

   - Workmanship is poor because painters lack the qualifications necessary to produce quality work, and painter certification documentation is deficient (AQO-35).

4. Assessment of Safety Significance: In assessing the allegations, the NRC Technical Review Team (TRT) reviewed the applicable training and qualification requirements. In the CPSES Final Safety Analysis Report (FSAR), Texas Utilities Electric Company (TUEC) commits to American National Standards Institute (ANSI) standard N101.4-1972, "Quality Assurance for Protective Coatings Applied to Nuclear Facilities," and Regulatory Guide 1.54 (June 1973), which endorses ANSI N101.4-1972, with comments. ANSI N101.4-1972 requires that the QA program include provisions for the qualification of application and inspection personnel.

   Effective with Revision 15 (April 30, 1981) of the FSAR, TUEC committed to NRC Regulatory Guide 1.58, Revision 1, with minor modifications. This regulatory guide endorses, with comments, ANSI N45.2.6-1978, "Qualification of Inspection, Examination, and Testing Personnel for Nuclear Power Plants." ANSI N45.2.6-1978 provides guidelines and criteria for the evaluation and qualification of inspection personnel.

   CPSES specification 2323-AS-31 "Protective Coating," in Appendix C, paragraphs 6.3a and 5.2b1, respectively, requires certification of coatings inspectors and applicators.

   Requirements for Certification of Inspection Personnel. The TRT reviewed each revision of the Texas Utilities Generating Company (TUGCO) procedures providing methods and requirements to qualify coatings inspectors. These procedures are: CP-QP-2.1, "Training of Inspection Personnel," CP-QP-2.3, "Documentation Within QA/QC Personnel Qualification File," and QI-QP-2.1-4,

"Qualification of Protective Coating Inspection Personnel." These procedures also specify requirements for documentation of training, testing, and certification activities.

ANSI N45.2.6-1978 defines the minimum capabilities required for each level of inspector certification. Capability is to be established by suitable evaluations of education, experience, training test results, and capability demonstration. The TRT examined evidence of capability evaluations, as discussed below.

The TRT reviewed the complete qualification files of 23 QC personnel certified between 1978 and October 1984, and portions of other files described hereafter. The TRT also interviewed 11 Level I and Level II inspectors, 2 Level III Quality Engineers (QEs), 2 former QC supervisors, and the former QA manager. The TRT did not contact coatings personnel not presently on site relative to training and qualification.

Certification of Level I Inspectors. The TRT found that the previous experience of inspectors was not in every case evaluated in accordance with applicable requirements. ANSI N45.2.6-1978 and TUGCO procedure CP-QP-2.1 require certain "related experience in equivalent inspection, examination, or testing activities" for each level of certification. ANSI N101.4-1972 states that an inspector's "qualifications shall include his prior training and inspection experience for work of comparable scope with generic coating systems similar to those used for the work in question." The TRT considers that this statement defines "equivalent" experience when cited as a qualification basis.

The TRT found previous experience as a journeyman applicator (painter) credited on inspector certifications, including the certification of four presently employed inspectors, as a basis for qualification. The TRT considers that, although experience as an applicator of nuclear coatings is beneficial, it does not constitute equivalent inspection experience, and is not a suitable basis for qualification, nor a suitable basis to waive indoctrination and training requirements.

The TRT found that education and previous work experience used as a basis of inspector qualification were not adequately documented in all cases. The TRT found 14 instances where the verification of education and previous experience was missing or incomplete. In a few of these cases, such verification was available from other uncontrolled files.

Factors other than education and experience may demonstrate inspector capability. ANSI N45.2.6-1978 and TUGCO procedure CP-QP-2.1 provide that required education and experience levels should be interpreted to recognize that job performance, training, and testing may provide reasonable assurance that an inspector may competently perform a task. In such cases, Regulatory Guide 1.58 requires documentation that demonstrates that the inspectors have the competence that would have been gained from the required education and experience. The TRT also evaluated other available evidence to demonstrate each inspector's capability. ANSI N45.2.6-1978, requires that on-the-job training (OJT) be included in the training program. The TRT questioned inspectors concerning OJT which they have given or received and found that their training regularly includes OJT, which

consists of inspector trainees performing actual inspections. The TRT found that OJT serves as a primary training vehicle for personnel without equivalent previous experience, which is one acceptable method for meeting experience requirements.

OJT records examined by the TRT showed the procedure(s) covered during the OJT session, the date and time they were covered, and the names of the trainee and instructor. However, these records did not provide sufficient detail to assess the quantity and quality of the OJT. OJT records did not identify activities, functions, or inspections performed, did not show that acceptable inspection documentation was prepared, and did not show that the requirements of the inspection work were successfully demonstrated by the trainee.

The TRT found that OJT requirements were often waived on the basis of previous experience and/or examination results. For example, OJT requirements were partially or completely waived for 14 of 24 inspectors certified to perform backfit test program inspections. Further, the TRT found that all examinations did not include practical tests for important operations, such as visual identification of film defects.

In its review of selected Level I examinations, the TRT found that written examinations primarily test the inspector's ability to identify specific work and inspection criteria, such as film thickness and ambient condition requirements. The TRT found that written examinations did not test the inspector's knowledge of applicable QA requirements, such as for instrument and document control, the method of operating instruments or performing important inspection tasks, or the precision characteristics of inspection methods and instruments.

The TRT reviewed selected examples of the answer keys used to grade examinations, and compared the responses given in answer keys to those given on examinations. The TRT found inconsistently or improperly graded examinations. In one instance, the answer key gave the answer as a description of the method for an inspection, whereas a test response that identified only the name of the inspection was given full credit. The TRT considers that these inconsistencies may obscure the inspector's inability to understand important requirements.

A number of examinations consisted of written and practical (e.g., demonstrated ability) test elements. On the basis of interviews and a review of records, the TRT learned that practical tests were graded on a pass/fail basis without written guidelines for grading. Practical tests included in various examinations provided 24 percent to 50 percent of the grade of the combined written and practical examination. The TRT noted that, as a result of scoring 50 points on the practical test elements, inspectors who achieved the required passing grade of 80 percent had, in fact, scored only 60 percent on the written portion of the examination.

The TRT considers that the formal classroom training did not assure the capability of inspectors because the training was primarily a review in preparation for the corresponding examination, and did not include a lesson plan showing an adequate review of necessary inspection requirements.

In one instance, a presently employed inspector was shown to have a color vision deficiency. The type of deficiency was not noted, and there was no objective evidence of the inspector's visual acuity under field conditions. One of the inspector's annual examinations, during which he failed to identify 9 of 12 test plates, was waived on the basis of a supplementary test given with colored pens.

The TRT finds that documentation provided by Level I inspector files was not adequate or sufficient to demonstrate that the required capability of all personnel had been achieved.

The TRT randomly selected 20 inspection reports generated between 1978 and October 1984, to verify the qualification of each inspector to perform the documented inspections at the date of the report. The TRT found no records for the inspector who signed report PC03511, of February 24, 1979. The signature is difficult to read, and the TRT could find no record of a similar signature for this individual in the Permanent Plant Records Vault, although the TRT found certification documentation for the other inspectors.

The TRT evaluated the process of Level I inspector recertification to determine how the proficiency of inspectors was maintained. The TRT reviewed approximately eight completed recertification forms, which showed that written, oral, or practical recertification examinations had been given. However, the TRT found no supporting evidence that written, oral, or practical examinations had actually been given for inspector recertification. The TRT found that recertification consists of an informal evaluation by the responsible QC supervisor, based on personal knowledge and supplemented by information from the responsible lead inspector.

TRT interviews disclosed that to maintain their proficiency, inspectors are directed to read revisions to governing documents. The TRT found documentation for one instance of required supplemental reading included in several inspectors' files, in accordance with the requirements of TUGCO procedure CP-QP-2.1. The TRT found no verification of reading, or records of formal training for other important revisions to governing documents, such as revision 2 of CPSES specification 2323-A5-31.

The TRT considers that the methods used at CPSES to recertify Level I coatings inspectors do not demonstrate the continued capability of these personnel. During the course of its interviews, the TRT asked inspectors to explain a number of generic and specific requirements and methods of implementing those requirements. These discussions were not detailed enough to fully assess the inspectors' understanding of requirements; however, in the opinion of the TRT, each inspector demonstrated an adequate understanding of methods and requirements for the topics covered.

Certification of OJT Instructors. TUGCO Procedure CP-QP-2.1, beginning with Revision 8, requires that OJT be conducted under the direct supervision of someone (e.g., Level I) certified as an OJT Instructor, or a Level II or Level III inspector. The basis of qualification of OJT Instructors is stated on the certification form given as an attachment to the procedure. The TRT interviewed coatings inspectors, and coatings QA

supervisors and examined coatings inspector qualification files (as previously noted) in order to evaluate implementation of this requirement.

The OJT instructor certification form contains entries for "type of examination given" (oral, written, practical) and "results of examination(s)." Certification forms examined by the TRT typically showed satisfactory examination results. The TRT found that, where a certification indicated a written test was conducted, the cited test is the inspector's original examination for Level I certification instead of an examination specific to instructor qualification. The TRT found that where a certification indicated that an oral examination was conducted, no direct oral examination occurred.

The TRT found that the "satisfactory evaluation of the individual's demonstrated proficiency" used to establish "reasonable assurance that the individual can competently perform as an OJT QC Instructor in this activity" (stated by the OJT Instructor certification form) is an informal evaluation conducted by the responsible QC supervisor. It is based on the supervisor's personal knowledge and information from the responsible lead inspector.

The TRT found that inspectors are not, in every instance, notified of their certification as OJT Instructors at the time of certification, nor are they specifically notified that they have been recertified. The TRT noted a requirement of TUGCO Procedure CP-QP-2.1, Revision 16, (July 17, 1984) that inspectors are responsible for determining their certification status and that since about June 1984, there is a report showing each inspector's certification status. As discussed under allegation AQO-61 below, the TRT identified two individuals who conducted OJT without being certified for that activity.

Based on the above, the TRT considers that the CPSES quality assurance program lacks sufficient controls to assure that OJT is conducted by qualified instructors.

Certification of Level II Inspectors. The capabilities described for Level II inspectors by ANSI N45.2.6-1978 include: planning inspections, evaluating the validity and acceptability of inspections, supervising inspection personnel, and qualifying lower level personnel. The TRT found that lead inspectors regularly performed the functions ascribed to Level II inspectors by ANSI N45.2.6-1978. Prior to June 1984, Level I inspectors were regularly appointed as lead inspectors.

The TRT found no document establishing the position of lead inspector, and no document assigning an individual as a lead inspector for coating work. The TRT found that inspectors and lead inspectors understand that the responsibilities of the lead inspectors consist of: interfacing with production supervision to accomplish needed inspection work on a timely basis; supervising other inspectors to the extent necessary to provide efficient performance of inspection work; monitoring the performance of inspectors, OJT instructors, and trainees; providing the first and primary level of response to the questions of other inspectors regarding technical and operational problems; providing feedback to QC supervision on the

performance and capabilities of other inspectors; and, contacting responsible QEs on questions or problems beyond the capability of the lead inspector. The TRT concluded that the position is verbally defined and assigned by a responsible supervisor.

The TRT found that TUGCO procedures require that certain functions be performed by lead inspectors. For example, TUGCO procedure QI-QP-11.4-26, Revision 6, paragraph 2.3.1.1.c, assigns lead inspectors to the task of reviewing and approving a log of environmental inspections. Further, certain requirements documented on Protective Coatings Technical Training Outlines are verified and signed by a lead inspector, and the responsible supervisor may indicate completion of other items on these outlines on the basis of statements by lead inspectors.

The TRT interviewed six recently certified Level II inspectors to determine their scope of training and examination. The Level II certification process consists essentially of an undocumented study and review of current requirements, a documented classroom review of requirements, and a written examination.

The TRT reviewed approximately six Level II examinations. The examinations tested knowledge of specific objective requirements in greater detail than for Level I examinations. The examinations did not demonstrate or establish the individual's capability either to perform the functions described by ANSI N45.2.6-1978 as listed above, or to perform the functions regularly required of lead inspectors and Level II inspectors in the coatings inspection program.

Certification of Level III Coatings Personnel. The TRT found that individuals assigned as QC supervisors at CPSES typically have Level III certifications. TUGCO Procedure CP-QP-2.1, Revision 16, provides that Level III Civil certifications include protective coatings in their area of responsibility. The TRT found one recent supervisor in the coatings QC inspection department who was certified as a Civil Level III, whose file does not include documented study of coating requirements and procedures, and whose resume does not clearly demonstrate previous technical experience with the generic coatings systems used at CPSES. As a supervisor, this individual attested to the capability of a number of inspectors and made other technical decisions concerning coatings inspection work.

TUGCO letter TXX-4262, August 21, 1984, identifies individuals who have been assigned to supervisory functions for the coatings quality control program since January 1982. It also identifies three individuals assigned such functions who did not have certifications for coating work. The TRT found that these individuals have signed QC inspector certification documentation, as QC supervisors, to verify evaluations of capability, and have made other technical decisions concerning coatings inspection work.

TUEC records do not demonstrate the capability of QC supervisors to perform their assigned functions. The TRT was unable to assess the effect of this finding upon the quality of coatings applied at CPSES.

Review of Individual Allegations

Backfit Test Program Training (AQO-22). The allegation is that coatings inspectors are required to conduct adhesion tests of applied coatings, as part of the backfit test program, without first completing formal training in the proper methods to be used in performing the tests. The testing method cited by the allegation requires operation of the Elcometer Model 106 adhesion tester. The implied significance of this allegation is that the tests may have been improperly performed and that the data generated may have resulted in the improper acceptance of coatings. (A discussion of the history and requirements of the backfit test program and the evaluation of the backfit test program inspection data are given in Coatings Category 1.)

Coatings inspectors performing backfit test program inspections are certified to TUGCO procedures QI-QP-11.4-23, "Reinspection of Seal Coated and Finish Coated Steel Substrates for Which Documentation is Missing or Discrepant," and/or QI-QP-11.4-23, "Reinspection of Protective Coatings on Concrete Substrates for Which Documentation is Missing or Discrepant." Each procedure requires the use of the Elcometer adhesion tester.

The TRT randomly selected 20 backfit test program inspection reports, and found that the inspectors who prepared the reports were properly certified at the date of each report. The TRT's review of logs since 1982 found one NCR, C-83-00852, which dispositioned 19 backfit test program inspections performed by an uncertified inspector.

The TRT also examined the files of the 24 QC inspectors certified to TUGCO procedures QI-QP-11.4-23 and/or QI-QP-11.4-24 between the start of the backfit test program and the present. As previously mentioned, ANSI N45.2.6-1978 requires that training include OJT. This standard further provides that uncertified personnel may be used "in data-taking assignments" provided they are supervised by qualified personnel. OJT for backfit test program adhesion testing and Tooke gauge film thickness measurements generally includes data-taking operations. Regulatory Guide 1.58 requires that, in such an instance, these trainees have completed training adequate to assure competent performance prior to performing data-taking OJT.

During its review of files, the TRT noted ten instances where records show that OJT for backfit test program training preceded study of appropriate requirements. The TRT also noted seven instances where OJT for backfit test program certification was completely waived; however, in each case the inspectors studied requirements and completed a written/practical exam prior to certification. The TRT found that inspectors have been certified for this inspection on the basis of the single demonstration of capability during a practical examination. The TRT has commented above on practical examination grading practices.

The TRT found that the training program does not require that an inspector trainee complete a formal training session or read applicable instructions prior to performing inspection tasks while participating in OJT. During interviews with inspectors, the TRT found that trainees are instructed to read the applicable requirements prior to OJT, but there is no consistent verification that the instruction is followed.

The TRT noted that TUGCO procedures QI-QP-11.4-23 and QI-QP-11.4-24 do not provide a detailed operational method for operating the Elcometer 106 adhesion tester. CPSES specification 2323-AS-31 directs that the instrument be operated in accordance with the manufacturer's recommendations. The TRT found that the Protective Coatings Technical Training Outlines do not show that inspectors have read the manufacturer's recommendations. The TRT could find no copy of the referenced manufacturer's instructions available at the QC inspectors' office or in the possession of inspectors, although a copy of the instructions was available from responsible coatings QEs upon request.

Since about July, 1984, TUGCO procedure QI-QP-11.4-29, "Use of Elcometer Adhesion Tester for Isolating Areas of Questionable Coating Adhesion," has been employed, as stated by the title of the procedure. This procedure describes a detailed operational method for use of the instrument.

The TRT noted a separate but similar deficiency in that TUGCO procedures do not provide a detailed operational method for the use of the magnetic dry film thickness gauge used for regular inspection work at CPSES (e.g. the non-backfit test program). CPSES specification 2323-AS-31 requires that this inspection be conducted in accordance with a standard consensus specification, Steel Structures Painting Council (SSPC) specification PA2-73T, which provides detailed instructions. The files of three current inspectors show no evidence that they have studied SSPC PA2-73T.

In the opinion of the TRT, based on an informal consensus of industry experience, the majority of possible operator-induced errors in the operation of the adhesion tester will result in lowering rather than raising the indicated adhesion values, and thus would show failure of coatings with acceptable adhesion. Further, it is the opinion of the TRT that, although misoperation of the instrument may adversely affect its calibration accuracy, the probability of this occurring is low. (The effect of calibration accuracy on the backfit test program data is assessed in detail in Coatings Category 1.)

The TRT considers that this allegation is substantially correct in that the training program does not provide adequate measures to assure that trainees are fully familiar with instructions and requirements prior to OJT; nor does the program demonstrate adequate inspection experience or testing where OJT was waived. However, such training as was given was beneficial. Further, the probability of the practices described affecting the backfit test program adhesion test data in a non-conservative manner is low.

Reading Lists (AQO-32). The allegation is that after a reading list was signed by QC inspectors, the document which they had acknowledged reading was exchanged for another document while the reading list acknowledgement form remained the same. The significance of this allegation is that inspectors might be held responsible for implementing requirements of which they are unaware.

The TRT did not identify any instance in which a reading list prepared as part of initial training showed evidence of being altered. The TRT reviewed certain reading lists with current inspectors and found the lists to be

accurate. As noted previously, the TRT found that evidence of compliance with the periodic reading requirements given by TUGCO procedure CP-QP-2.1 is not generally present in inspector personnel files.

Qualifications of Lead Coatings Inspectors (AQO-33). The allegation is that many problems with the coatings inspection program occurred because of the inexperience of one of the lead inspectors in the coatings QA/QC department. The allegation cites an instance in which this individual identified rust on an A-frame at the Seal Table room as being residue of Ameron D-6 primer. The implied significance of this allegation is that inadequate technical knowledge by supervisory personnel will contribute to defective inspection work and to defective analysis of the results of inspection.

In assessing this allegation, the TRT notes that the various oxides of iron are typically described as "reddish-brown" to "black"; the color of the primer coating is typically described as "reddish-grey."

The TRT reviewed the permanent file of the lead inspector named in the allegation. The inspector's resume shows 5 years of experience as a journeyman and foreman painter for nuclear coating work, and 19 years as a journeyman painter for industrial and commercial coating work. Previous coatings inspection experience was limited to one 3-month period of intermittent coatings inspection. The TRT found no indication on the individual's resume of training in the technical characteristics of protective coating systems or in coatings inspection methods prior to this person's arrival on site.

Verification of previous employment and education was not in the file, but experience and education were cited as a basis for qualification. Verification efforts by TUEC during the course of the TRT review showed that the individual had not received a high school diploma as claimed, and that the work experience claimed was inaccurate. The TRT found that certifications for this individual completely or partially waived OJT requirements on the basis of his previous experience. The TRT also found that answers on this person's qualifying examinations differed from the answers on the prepared answer key for the examinations.

The TRT found that this person was certified to perform backfit test program inspections 2 weeks after being hired, and as a Level I inspector for other functions 4 weeks after hiring, was also appointed as a lead inspector within 4 weeks of hiring, and was certified as an OJT Instructor approximately 6 weeks after hiring. As a lead inspector, this individual verified that inspector trainees had successfully completed requisite training. (The individual named by the allegation was released from employment in about May 1983.)

The TRT reviewed documentation of the incident cited in the allegation, including inspection reports PC47854 (11/4/82), PC47874 (11/5/82), and NCR C-82-02403 (12/30/82), with attached inspection reports. The TRT found evidence in these records to demonstrate that three other inspectors believed the residue was rust, although there was evidence that responsible QEs disagreed with the evaluation made by these inspectors.

The TRT concludes that records do not demonstrate the capability of the individual named by the allegation to perform the duties required for his position as Level I inspector, OJT instructor, and lead inspector. The TRT did not determine the extent to which the inadequate qualifications of this individual may have affected the quality of coatings applied at CPSES. However, the instance cited by this allegation demonstrates an example of defective evaluation on the part of inspectors or responsible QEs. The TRT was not able to clearly identify which group made a defective evaluation, but noted that the adhesion of the coatings on the A-frame failed after the original engineering identification of the residue as primer. Repair of failed areas is documented in NCR C-82-02403.

Qualification of Instructors (AQO-61a, AQO-61b, AQO-61c). These allegations are that Level I inspectors not properly qualified to provide OJT instruction are training other Level I inspectors, that management was aware that some inspectors were trained by unqualified instructors and took no corrective action, and that Level II inspectors sign-off for training conducted by Level I inspectors. The implied significance of this allegation is that inadequate training of new inspectors will result, and that these personnel will not be able to provide adequate inspection of coating work.

In assessing this allegation, the TRT reviewed the OJT records for six inspectors certified prior to October 1983, and the files of ten inspectors certified since that date. This review identified 30 individuals who conducted OJT. The TRT found two instances of Level I inspectors, not yet certified to conduct OJT, who signed OJT records as instructors during 1984. The TRT found no evidence that this deviation from requirements was detected or identified as a nonconforming condition even though management sign-off of OJT records and instructor certification was evident. The TRT found no indication that OJT was conducted by individuals other than those who had signed the OJT record form, or that formal training was conducted by individuals other than those documented on available records.

The TRT has noted that lead inspectors and QC Supervisors verify the completion of various training requirements, as indicated by their signatures on the inspector's Protective Coatings Technical Training Outline.

Qualification of Painters (AQO-35). The allegation is that the abilities of coating application personnel are inadequate and that there are problems with workmanship, quality of work, and the indoctrination and qualification of painters. The allegation cites as an instance that the documentation of painter qualifications and in-process work did not consistently satisfy requirements. The implied safety significance of this allegation is that unqualified painters might produce defective work.

This allegation does not identify areas for which the documentation of in-process work is deficient. (The TRT has addressed general and specific concerns about work and inspection procedures and the adequacy of coating work documentation in Coatings Categories 1 through 6.)

In assessing this allegation, the TRT examined the requirements, methods, and practices used to qualify painters to apply coatings. The TRT also reviewed the requirements of applicable Brown & Root (B&R) procedures,

examined painter certification files, and interviewed painters and supervisory personnel.

ANSI N101.4-1972 requires that "application personnel shall be qualified in accordance with the coating applicator's qualification procedures." The TRT found that B&R procedure CCP-30, "Coating Steel Substrates Inside Reactor Building & Radiation Areas," CCP-30A, "Coating Steel Substrates Inside Reactor Building & Radiation Areas," and CCP-40 "Protective Coating of Concrete Surfaces" have provided qualification methods in each revision. The painter certification form corresponds to the form recommended by ANSI N101.4-1972.

The TRT interviewed two painter foremen and four journeymen painters and verified that the qualification files of these painters correspond to the information given by a current painter qualification summary listing distributed for use in the field. During the interviews, the TRT asked questions to establish the character and extent of the training given to journeymen. The TRT found that training cited by certifications was given as stated. The TRT found that these journeymen exhibited an adequate knowledge of work requirements.

During a review of logs since 1982, the TRT noted only one NCR resulting from application by an unqualified journeyman, NCR C-83-00310 (Revision 1, January 31, 1983).

The TRT interviewed one painting supervisor who has supervised painter demonstration applications and conducted the formal training session given to painters. The TRT asked questions to establish the nature and character of training and qualification practices since 1980, and found no discrepancies with the statements made by the painters.

This supervisor gave the TRT copies of the lesson plans presently used for classroom training and copies of an examination given to painters upon conclusion of the training session. The TRT reviewed the lesson plans and compared them against project requirements. The TRT found that, in general, the lesson plans contain adequate, useful, and accurate information that is of substantial value in a well-conducted training session. However, the TRT found the following subjects inaccurately, incompletely, or not addressed by the lesson plans:

- Inspection hold points are not adequately described. The lesson plans do not define "hold point,' or include sufficient detail to clearly identify that there are certain inspection verifications required immediately prior to coating application.

- Good application techniques are not fully covered by the lesson plans. There is no evidence of a review of the proper use of spray equipment, such as adjustment of the equipment, techniques to minimize spray application errors, and techniques to spray apply coatings to complex shapes. There is no evidence of discussion of good brushing techniques or the treatment of brushing to accommodate the characteristics of certain materials. (The TRT noted that painters must complete a practical test prior to certification.)

- There is no evidence of training (or testing) in the proper and accurate use of the instruments regularly used by painters to check the accuracy of their work, such as dry film and wet film thickness gauges.

The TRT found that examinations accurately reflect project requirements, are consistently used, accurately graded, and regularly updated to reflect new requirements. The TRT noted that more complex examinations have been given to certain foremen.

The TRT randomly selected the names of six journeymen identified as certified applicators by inspection records between 1979 and 1984, and verified that each journeyman was certified for the specified application on the dates shown by inspection records.

The TRT also reviewed the certification files of 14 painters, including the 6 interviewed journeymen. The TRT found that, in some instances, painter certification documentation contains misleading or incomplete information which is cited by certifications as a qualification basis. The TRT is concerned that such statements might be used as a basis to assign painters to work beyond their true level of capabilities.

For example, some certifications state that, "employee has previous experience as a painter," without identifying the nature or extent of the stated experience. The TRT found that the previous experience of certain journeymen does not include full-time professional experience or experience applying the generic coating types used at CPSES, or previous experience with related nuclear, industrial, commercial, or architectural coatings.

Further, most certifications state that the employee has "experience with the following product types: zincs, phenolines, epoxies, latexes, enamels, and thinners," and do not describe the type of experience. The TRT found that such experience was stated in cases when painters did not have experience with these generic coatings prior to being hired at CPSES, and the cited experience consisted of providing support to and observing certified applicators at CPSES.

The TRT found that, with the exception of the deficiencies noted above, the CPSES system of qualifying applicators is effective and in accordance with requirements and the general practices used for nuclear coating work.

5. Conclusions and Staff Positions: The TRT concludes that AQO-22 is partially substantiated and that personnel have performed backfit test program adhesion testing without first receiving all the appropriate training in the methods and requirements for this inspection. The TRT further concludes that this deficiency tends to cause data errors in a conservative direction, and so should not have a significant adverse impact upon backfit test program data.

The TRT concludes that allegation AQO-32 is unsubstantiated.

The TRT concludes that allegation AQO-33 is substantiated, but was not able to assess the significance of the deficiency alleged.

The TRT concludes that allegations AQO-61a and AQO-61b are substantiated and that the coatings quality control program lacks sufficient controls to assure the capability of instructors or the accurate assessment of capability demonstrated during training. The TRT concludes that allegation AQO-61c cannot be supported by tangible evidence.

The TRT concludes that allegation AQO-35 was partially substantiated by the evidence examined; however, the TRT considers the specific deficiencies noted to be without significance to completed work.

The TRT's overall evaluation of the coatings QC inspector qualification system is that, as implemented, it lacks controls sufficient to assure the required competence of personnel performing functions ascribed to Level I, Level II, and Level III personnel by ANSI N45.2.6-1978.

The TRT's overall evaluation of the painter qualification system is that, with the exception of specific noted deficiencies, the system is adequate to satisfy all requirements.

These deficiencies, although not of safety significance in the coatings area must be considered in evaluating the effectiveness of TUEC's overall QA/QC program.

Following completion of its onsite work, the TRT Coatings Group attempted to contact all of the allegers to discuss its findings of their original concerns and to obtain any additional comments from them. A summary of the followup interviews is included in Section 2.2.3 of this Appendix.

6. Actions Required: None.

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14. ABSTRACT (200 words or less)
Supplement 9 to the Safety Evaluation Report for the Texas Utilities Electric Company's application for a license to operate Comanche Peak Steam Electric Station, Units 1 and 2 located in Somervell County, Texas, has been prepared jointly by the Office of Reactor Regulation and the Comanche Peak Technical Review Team of the U. S. Nuclear Regulatory Commission. This supplement addresses Texas Utilities' analyses in support of its request to amend the Comanche Peak Final Safety Analysis Report to eliminate the commitment that coatings inside the reactor Containment Building be qualified for Units 1 and 2. In addition, this supplement provides the results of the staff's evaluation and resolution of 62 technical concerns and allegations in the coatings area for Unit 1. Because of the favorable resolution of the items discussed in this report, the staff concludes for the issues considered herein, that there is reasonable assurance that the facility can be operated without endangering the health and safety of the public.

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