AFFIDAVIT

My name is Harold Hudson. I have worked for 5½ years at Diablo Canyon, as a Pullman Power Products pipefitter, QA/QC inspector, QA program Internal Auditor and Lead Auditor. I am about to resign my job, in large part because of my family's fears about the safety of the plant if it begins commercial operation. I am providing this statement to answer a myth -- that quality assurance at Diablo Canyon was acceptable because problems were identified -- through a case study -- pipe ~~support~~ rupture restraints. Problems indeed were identified, which is one of the three steps necessary for a good audit or QA program. But it is not sufficient. The problems kept recurring. That is because the QA program failed in its second and third responsibilities -- identifying any similar deficiencies that exist; and identifying and addressing the cause of the problem, to prevent recurrence.

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Repetitive cases of previously identified violations represent a deliberate quality assurance breakdown, not a success. The history of the pipe rupture restraint program is a series of repetitive violations.

A History of the Pullman Power Products (M.W. Kellogg) Pipe Rupture Restraint Construction Program at the Diablo Canyon Nuclear Plant, California.
Prepared by Harold Hudson 5/26/84

Pullman Power Products (M.W. Kellogg Co.) was contracted by the Pacific Gas and Electric Company to install piping, pipe supports

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and pipe rupture restraints at the Diablo Canyon Nuclear Plant. Pipe Rupture Restraints are used to insure that if a pipe filled with steam or pressurized water rupture, surrounding equipment would be protected by restraining the pipe at critical points. If not restrained, the steam or pressurized water flowing from a broken pipe would cause the pipe to whip back and forth damaging surrounding equipment. Pipe Rupture Restraints take on special importance at the Diablo Canyon Plant due to the close proximity of the Hosgri Earthquake Fault and the effect an earthquake would have in piping systems at the plant.

In May 1970, M.W. Kellogg (PPP) would sign PG&E Contract Specification #8711 for erecting Main Systems Piping and furnishing, fabricating, and erecting the balance of power plant piping. C.S. #8711 covered piping, valves, hangers and pipe supports. Actual on site construction would begin in 1971. In 1971 PG&E would issue Contract Specification #8833XR to furnish and erect structural steel for Units 1 and 2. M.W.. Kellogg's (PPP) original work under this contract was to erect containment structure pipe rupture restraints for Units 1 and 2 and the reactor coolant loop, cross over pipe restraints for Units 1 and 2.

The C.S.#8833XR construction schedule called for Unit #1 Pipe Rupture Restraint erection to start on 7-8-72 and Unit #2 erection to start 3-8-73. The framing for Pipe Rupture Restraints would be subject to a Quality Assurance Program in accordance with section 3 of the contract. In addition all Pipe Rupture Restraint welding procedures were to be prepared and

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qualified in accordance with the American Welding Society (AWS) D1.0-69 or D1.1-72 Codes. PG&E would designate Pipe Rupture Restraints as Design Class I work requiring full Quality Assurance compliance. But it should be noted that neither C.S. #8833XR or C.S.#8711 made any reference to or made any commitment to comply with 10 CFRCO Appendix B, the Code of Federal Regulations concerning Quality Assurance requirements.

M.W. Kellogg (Pullman) would erect Pipe Rupture Restraints with little attention to Quality Assurance. On 9-19-73, the PG&E Project Superintendent sent to Kellogg a letter concerning Kellogg's Quality Assurance Program. This Letter stated that past audits conducted both by the Atomic Energy Commission and PG&E Quality Assurance Dept. had disclosed numerous QA deficiencies. These deficiencies usually fell into two categories.

1. Failure to follow existing Quality Assurance procedures.
2. Failure to upgrade Quality Assurance procedures.

PG&E requested Kellogg to place more emphasis on their QA audit program to eliminate most deficiencies before the next AEC and PG&E audits.

On 10-24-73 Kellogg reported the results of their first audit of the Rupture Restraint QA Program. One of the areas audited was "Adherence to Correct Installation Procedures." Per the report all aspects of Rupture Restraint installation were checked to insure compliance to a letter (unavailable for review) approved by PG&E's A.G. Walters on 10-19-72. The audit report stated that "it appears that Spec 8833XR and 8711 as stated in the body of the letter are being complied with completely

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but, it would seem to be beneficial if all the references stated in the letter were condensed into a single procedure to be used at this complex." The initial Rupture Restraint construction did not have an approved Engineering Specification to direct the work but merely a letter referencing requirements for erection and Quality Assurance.

But PG&E would come to a different conclusion about Kellogg's Pipe Rupture Restraint QA program.

During October and November 1973, PG&E conducted an audit to verify that Pipe Hangers and Pipe Rupture Restraints were fabricated, furnished and erected in accordance with Spec 8711, PG&E and Kellogg QA manuals. It should be noted that PG&E did not audit Restraints against the correct Contract Specification, Spec. 8833XR but against Spec 8711 which covered Pipe Supports and not Pipe Rupture Restraints. The same mistake was made in the Kellogg audit of 10-24-73. Why PG&E did not include Spec 8833XR which had placed Rupture Restraints under specific QA requirements is unknown. This would be a reccurring problem in the early years of construction. Rupture Restraint and Pipe Supports would often be confused as one and the same. They would be audited to the same Spec, and share the same construction and QA requirements.

The audit disclosed that Kellogg (Pullman) and PG&E's General Construction Dept. departed significantly from the requirements of the Specification and PG&E's Quality Assurance Manual. Kellogg's(Pullman) Quality Assurance program did not comply with Section 4 of Spec 8711 and PG&E's Procedure PRP-4. It also disclosed that the PG&E Mechanical Department's surveillance

program did not comply with Procedure PRC-7.

As a result, PG&E's Project Superintendent stopped work on the installation of the pipe hangers and rupture restraints and directed that corrective action be initiated to resolve all deficiencies and preclude recurrence.

The audit reviewed Kellogg's (Pullman) Quality Assurance Manual, with respect to the pipe hangers and restraints, for adequacy and compliance to Spec 8711 and QA Procedure PRP-4. Section 4 of Spec 8711 set forth the requirements of the standard "Supplementary Specifications for Contractor's Quality Assurance Program" included in Procedure PRP-4.

Kellogg's (Pullman) QA Manual complied with Section 4 of the Specifications but the Manual did not specifically address itself to, nor completely apply to the control of pipe hangers and restraints. Because of this Kellogg (Pullman) had written an "Engineering Specification", ESD223, establishing a QA program applicable to the control of hangers and restraints. The intent of ESD223 was to set forth procedures and instructions to the field QA inspectors, engineers and foreman implementing the policy stated in the QA Manual. The audit revealed that ESD223 established QA policy instead of providing instructions on how to implement the policy stated in the Manual.

ESD223 did not meet all the requirements of Section 4 of the Spec. Deficiencies were noted in the areas of document review and control, qualification of special processes and personnel, work procurement control, receipt inspection of material identification control and status of material, nonconforming material control, inspection and test records and inspection and test plans. The hanger and restraint QA program was found to be in

violation of Procedure PRP-4.

A separate QA Manual/QA Program was established for Pipe Supports and Rupture Restraints. This program was based on Contract Spec 8711 QA Requirements. Again C.S.#8833XR was ignored. Rupture Restraint QA requirements were referenced in CS #8833XR, not C.S. #8711. No commitment was made to 10CFR50 Appendix B and/or ANSI N45.2 QA Requirements. ANSI N45.2 had recently come into being to provide QA coverage for areas that fell outside ASME code QA requirements which Pipe Supports and Rupture Restraints did. Also, Discrepancy Reports identifying and dispositioning the discrepant item existing in work completed were to be initiated, and steps to preclude recurrence implemented.

Another item audited was the receipt, storage and installation of pipe hangers and rupture restraints.

The audit revealed:

1. Kellogg's (Pullman) receipt inspections were only checks for road damage and completeness of material only. Kellogg did perform surveillance inspections of stored assemblies.
2. PG&E Civil Dept. provided the inspection and documentation to assure that procurement requirements had been met. Several receiving inspection forms which noted contingencies had not been completed. These items had not been placed on "hold" or withheld from installation. The Resident's Instructions did not require identification and segregation of non-conforming items. Additionally, receiving reports for all restrainst could not be located.
3. Kellogg (Pullman) had not determined or received a written release from PG&E stating that the procurement requirements had been met.
4. Except for ultrasonic inspection, Kellogg documented their inspections on "marked-up" erection drawings. The method of recording inspections and acceptance criteria were not set forth in an instruction, and the auditor had difficulty determining the inspection status. The auditor found that not all in-process inspection of workmanship and technique required by the AWS Code were being performed.
5. Some welders were welding materials of greater thickness than they were qualified.
6. Welding was not in complete accordance with the assigned weld procedures. Several of the non-essential variables had been altered or were not being complied with.

7. Provisions for the installation and inspection of high strength steel bolts were not in accordance with the AISC Code.

The recommended corrective action for these findings was the same as for Audit Item No. I. stated as above.

Another item audited was PG&E's Resident Mechanical Engineers surveillance system of the fabricating, furnishing and installing of pipe hangers and rupture restraints.

The audit revealed that surveillance of the receipt and installation of pipe hangers and rupture restraints were performed by Power Plant Piping Group. The Resident's written instructions to this group were set forth in MFI-2. But MFI-2 instructions did not specifically address surveillance of pipe hangers and restraints.

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Corrective action was to issue written instructions for surveillance of pipe hangers and restraints. Thus this audit revealed that containment rupture restraint erection was in noncompliance to Spec 8711 and presumably Spec 8833XR, which had similar QA requirements.

It was during this same time frame that other problems were identified in the Kellogg's QA Program. A Kellogg Internal Audit dated 9-6-73 revealed that the N.D.E. Personnel Qualification Program was not included in the engineering specifications, thereby making it part of the Kellogg QA Program and thus requiring PG&E approval of each page and each revision.. As a result of this audit NDE Personnel Qualifications Requirements were incorporated into ESD 235 and ESD 237, making these requirements part of the QA Program and subject to PG&E review and approval.

In 1973 the American National Standards Institute (ANSI) would issue ANSI N4S.2.6, which defined an acceptable method

for implementing 10CFR50 Appendix B requirements for "Qualification of Inspection, Examination, and Testing Personnel for the Construction Phase of Nuclear Power Plants". Kellogg's Corporate QA Manual would be revised in 3-19-74 and its Corporate Field Installation Manual would be revised on 4-1-74 to implement ANSI N45.2.6. A 12-12-74 Kellogg Interoffice Correspondence from the Corporate Director of QA, E.F. Gerwin, would only suggest/recommend to the Diablo Canyon site QA/QC Manager that he implement ANSI N45.2.6 requirements. A subsequent Interoffice Correspondence from the Kellogg Corporate QA Dept., dated 12-17-74, would direct the site QA/QC Manager to put into effect ANSI N45.2.6 "at your earliest possible convenience".

A Kellogg Corporate Management Audit of the Diablo Canyon job site on April 3,4, and 5, 1975, revealed nonconformities in the area of "updating of Certificate of Qualification Records" and recommended complete review of personnel records by the Field QA/QC Manager. Field QA/QC Manager J.P. Runyan responded to the Corporate Audit on an I.O.C. dated 5-13-75, stating, "Personnel records review has been performed and updated. We have also updated our records in an attempt to comply with ANSI N45.2..6". Runyan, on 6-15-75 would revise the ESD 237 Certificate of Qualification card for Quality Assurance Technicians and Inspectors to read "qualified in accordance with SNT-TC-1A and/or ANSI N45.2.6." As a result, I believe that Field QA/QC manager J.P. Runyan deliberiately falsified QA Personnel Certification Records to give the appearance of compliance to

ANSI N45.2.6 requirements when no such compliance was implemented. Runyan, in his 5-13-75 response to the Corporate Audit stated: "It should be noted that it is virtually impossible to comply totally to N45.2.6 because of experience requirements. We cannot hire personnel that meet the experience requirements for the salary scale we offer. Even if the money was available, it would be difficult to find qualified people. We are taking the approach of qualification based on performance in a specific job." This was a nonconformance to ESD235 and ESD 237 QA/QC personnel qualification requirements, both ANSI N45.2.6 and SNT-TC-IA qualification requirements and the intent of 10CFR50 App. B. Criteria II, IX and IVII. As a result, the Kellogg attempt to upgrade its QA Program was a dismal failure resulting in falsified records. It should be noted that Kellogg did not revise its QA Manual to reflect the attempted ANSI N45.2.6 compliance and that PG&E did not revise C.S. #8711 or C.S. #8833XR to direct compliance to ANSI N45.2.6.

In August 1973, the U.S. Atomic Energy Commission issued Regulatory Guide 1.29, which indicated that "nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of earthquakes without loss of capability to perform their safety functions". It also indicated that pertinent requirements of Appendix B to 10CFR50 (Quality Assurance Criteria for Design, Construction and Operation of Nuclear Power Plants) would apply to all activities affecting the safety related functions of the identified structures, systems, and components, including their foundations and supports. The discovery of the Hosgri earthquake fault off the coas

of the Diablo Canyon Plant placed the power plant within the Seismic Design classification established by the U.S. AEC in its Regulatory Guide 1.29 and made 10CFR50 Appendix B QA Criteria a necessary part of PG&E's design and construction program. But PG&E did not revise its C.S. #8711 or C.S. #8833XR to require Kellogg's construction program to comply with the QA requirements of 10CFR50, Appendix B. PG&E and Pullman have contended that the Piping construction program which was based on ASME Section III Code requirements meet the intent of 10CFR50, App. B. But the Pipe Support and Pipe Rupture Restraint construction programs were not based on ASME SEction III, and were not required by Contract Spec to meet 10CFR50, App. B. The result was that pipe support and rupture restraint QA programs were not based on nor did they comply with the QA requirements of 10CFR50, Appendix B.

The seismic analysis and reanalysis to withstand a major earthquake resulted in redesign and additional construction of hangers, supports, and rupture restraints in an ongoing process. With the confirmation of the Hosgri Fault in 1973/1974, there was an upgrading program instituted to beef up existing hangers and rupture restraints. This program was called the "Hosgri Rework Program." The reanalysis and subsequent work granted to Kellogg, including the Hosgri Program was performed by Kellogg/Pullman in 1975, 1976 and 1977. The erection of Pipe Rupture Restraints expanded to piping systems in all areas of the power plant.

In 1974, PG&E contracted Nuclear Services Corporation to design the additional pipe Rupture Restraints which were required to withstand a 7.5 earthquake and contracted

Bostrom ~~Bartron~~ Bergen Metal Products to fabricate the restraints. Kellogg/Pullman would perform the erection of these Pipe Rupture Restraints.

On 1-14-74, Engineering Specification Diablo (ESD) 243, Pipe Rupture Restraints, was issued by Kellogg and on 2-1-74 a revision to the ESD was approved and published. Most of the ESD requirements were copied from PG&E Spec 8833XR and the AWS Code D1.0-69. The 2-1-74 revision to ESD 243 required all Rupture Restraint welds to be made with weld procedure Code 7/8, preheat of 50 F minimum with welder verification only, no preheat check by QA other than periodic monitoring during welder audits, and no documentation of preheat or interpass temperature. Visual inspection of fit up and final inspection with ultrasonic examination of all full penetration welds was required. For over a year these were the only QA/QC requirements for welding on Rupture Restraints.

A problem which arose in these years was QA/QC directing production work. The Kellogg (Pullman) QA/QC Manager issued an Interoffice Correspondence on 1-31-74 stating that superintendents had complained of QA Inspectors talking to and giving work instructions to foremen and pipefitters. He stated that "from now on, no support or rupture restraint QA Inspector shall discuss any rework, defective support problem or engineering spec. requirements with foremen, general foremen, or pipefitters.

It was necessary on 6-17-74 for the QA/QC Supervisor to issue an Interoffice Correspondence further clarifying the role of QA. He stated that QA is not an engineering service

and then went on to state what functions QA would perform.

QA/QC was not to direct production work or to provide engineering services at the Diablo Canyon Plant. It is questioned just how much of this type work QA/QC did. What functions QA/QC would perform would develop as the Rupture Restraint erection program progressed.

On 3-27-74 a Kellogg (Pullman) internal audit of the pipe support documentation of completed supports ~~(attachment 3A)~~ HOH revealed several deficiencies. The corrective action for one of these deficiencies would later play a role in a rupture restraint documentation problem. The audit revealed that some process sheets did not have the proper amount of inspection points checked off. The audit's corrective action directed that "any inspection points that do not apply to a particular support shall be noted with a "N/A"." Thus inspectors were given the authority on pipe support process sheets to check N/A "not applicable" for inspection hold points that they felt did not apply. The problem of N/Aing inspection hold points would arise in rupture restraints in the future.

A problem in the rupture restraint weld documentation program would be revealed in a Kellogg (Pullman) internal audit of pipe rupture restraints on 5-13-74. The audit revealed inspector's "Daily inspection Log" which showed field welds in rupture restraints. Their status was in compliance with ESD 24~~7~~3. But the actual field weld process sheet used to document the individual weld did not show a date when the welding operation was completed nor whether a final visual inspection was performed. The audit also revealed that most RR field welds in

the Unit 1 Auxiliary Building showed poor workmanship. The conclusions of the audit were that "if possible, a date should be shown on the process sheet when an operation is completed" and that "field welds on the Unit 1 Rupture Restraints in the Auxiliary Building should be reinspected, and a modified Process Sheet should be made up to show 100% or final inspection of these welds." No mention was made of the condition of Restraints in other parts of the plant. It would not be until May 1975 that these conclusions concerning weld process sheet documentation would be incorporated into the requirements of ESD 243. Rupture Restraints erection would continue with only cursory QA/QC participation.

On 12-24-74 Discrepancy Report #2654 was written on RR 1031-5RT, Unit 1, GW area. "Cracks" were reported in base material 6" long at FW2C and FW2F. Ultrasonic examination revealed indentations to be laminar in nature, 1" below the flange face. Indentations were ground to remove and new weld metal was added. This was the ~~final~~ FIRST indication that a cracking problem was developing in rupture restraints. Many more similar situations would arise.

In February 1975, PG&E would perform Audit No. 75-2 on Kellogg (Pullman) to verify that piping supports and rupture restraints were installed per PG&E and Kellogg QA Manuals, Specs 8711 and 8833XR and the FSAR. The audit discovered departure from prescribed quality procedures in the areas of drawing control, weld electrode control, ultrasonic equipment calibration, and PG&E surveillance inspection documentation. The audit stated, "individually, the departures were not of

major significance; however, collectively the departures indicate the need for a more comprehensive internal audit system."

Since the beginning of construction in 1972, Kellogg (Pullman) had performed only two internal audits on rupture restraints. This was in October 1973 and March 1974. Kellogg had been performing internal audits but mainly on the erection of piping with occasional audits on hanger supports. Because of this PG&E audit, Kellog would begin to audit rupture restraint work more often.

As a result of a Kellogg Internal Audit of drawing control for rupture restraints on 3-24-75, which discovered out of revision drawing being used for erection, the QA/QC supervisor issued an Interoffice Correspondence dated 4-3-75 directing all R.R. drawing to be audited once a month by QA inspectors; that the Pipe Support Dept. (rupture restraints were included in this department) be added to the Chief Field Engineer's drawing distribution list for R.R. revision update; and that out-of-revision drawings discovered be updated by the inspectors responsible. Thus it became the Inspector's responsibility to control drawing for rupture restraints.

By the spring of 1975, it was becoming apparent to Kellogg (Pullman) QA management that a lack of preheat for welding was becoming a problem.

On 4-25-75, the Kellogg (Pullman) QA/QC Manager issued an Interoffice Correspondence to all support inspectors stating that the A.W.S. Code required preheat when welding structural members if the material thickness exceeded 3/4". He stated that weld procedure 206 indicated preheat requirements for different material thicknesses and that these requirements applied to all WON

welding processes. Thus in many cases two welding procedures would have to be used to make a weld. He added that the temperature should be maintained during the welding process; and that inspectors should note on the process sheet that preheat was checked and give the approximate temperature.

Revision #5 to ESD 243, dated 5-6-75, added authorization to use weld code 205 or 206 for vertical butt welds, 45° angle gusset plates, 30° groove welds with backing, and 45° groove welds with backing. This revision also clarified and expanded welding inspection and documentation requirements to include seven sequential steps with six QC hold points (production could not proceed until the hold point was signed by QC) as follows:

1. Verify material, clean and fit up. (H.P.)
2. Preheat temperature (H.P.)
3. ~~Route Pass~~ Root Pass (H.P.)
4. 10% inspect multiple pass fillets (H.P.)
5. Weld complete
6. Final visual (H.P.)
7. N.D.E. completed weld (H.P.)

With revision #5 to ESD 243, verification of preheats became a QC function instead of a production function. Process sheets would now be issued detailing the operation sequences for each weld and specifying where QC Inspections were required. But this revision would not be fully implemented. Process sheets for rupture restraint #148, would have welding performed as late as April 1976 which did not comply with the requirements of revision #5 to ESD 243.

Another problem that arose was the fact that the process sheets listed field weld numbers but did not indicate the type of weld being made (fillet, groove, etc). This would cause problems at a later date when process sheets, field

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layout and actual field conditions would not match and the QA/QC dept. would perform a restamping program to make them match.

Even with revision #5 to ESD 243, preheating of welds remained a problem. On 9-17 and 19, 1975, PG&E performed a quality control audit of the Kellogg (Pullman) company's welding on pipe rupture restraints. This audit found that QA personnel allowed welders to weld without verifying minimum preheat and interpass temperatures. As a result of this audits the Kellogg (Pullman) QA/QC Manager issued an Interoffice Correspondence, date 9-22-75, stating that welders were not preheating and that Inspectors were required to monitor preheat and interpass temperatures. He pointed out that these temperatures must be maintained during the welding process and when checked, recorded on the process sheet.

Also in response to the P&G&E audit, the QA/QC Manager sent a letter to PG&E, dated 10-6-75, stating corrective action had been taken to assure that preheat requirements were being followed and applied in compliance with established procedures. This letter also stated a meeting had been held with the Superintendent in charge of Rupture Restraints to establish production responsibilities with regard to preheating.

An official response to the PG&E audit was made by the Kellogg (Pullman) QA/QC Manager on 10-9-75, when he issued Descrepancy Report #2969 stating that rupture restraints in the field had welds completed without proper preheat. PG&E's official recommended disposition was to "accept as is based on acceptance of ultrasonic testing."

The problem of inadequate preheating of welds had now been officially recognized by both Kellogg (Pullman) and PG&E, with corrective action promised. Up to this time Kellogg (Pullman Field Engineers had been providing minimal engineering services for welding rupture restraints. These engineers had been primarily concerned with the erection of piping and pipe hanger supports. Because of the continuing problems with weld cracking in restricted joints, the QA/QC Manager on 10-23-75, issued an Interoffice Correspondence to QC Support (RESTRAINT) Inspectors which in effect ordered inspectors to perform engineering duties. He stated that inspectors should take the following action in an effort to avoid the cracks:

1. Suggest to the production personnel that they use more heat, preferably 300° or more. He notes that this is not required but is highly recommended.
2. Check to assure that the temperature is maintained during the complete welding cycle.
3. Recommend a welding sequence which will induce less stress.
4. After weld is complete let it cool completely before final visual inspection then examine closely for tight cracks.
5. Make sure that there are no visible cracks before calling for U.T. inspection.

Suggesting to production personnel that more heat be applied to welds and recommending welding sequences should have been a designated engineering function. It was not, and as a result of this correspondence it became the QC inspector's responsibility in direct contradiction to the QA/QC Manager's directions of 1/31/74. QC Inspectors were now to assume engineering duties. This correspondence also would tentatively identify additional reasons for the cracking problem, welds in restricted joints and welding sequences.

The weld cracking problem in Rupture Restraints would continue. Beside the weld cracking problem there would also be a problem in identifying welds after they were made. PG&E during the week of Oct. 27, 1975, conducted Audit No. ~~2c~~75-4 HOH to verify compliance to PRP-4, Suppliers'/Contractors' Quality Assurance Programs and ESD 243. Four items were audited with one discrepancy found. The audit disclosed that the procedures for identifying welds were not being implemented uniformly. Four rupture restraints were audited for workmanship and on two of them weld identification inconsistencies were noted. Restraint No. 1047.4R7 had three welds stamped with a welders ID letters, but the process sheets did not reflect the welder's ID letters. On one of the above welds the process sheet indicated that the ultrasonic examination had been completed, but the weld had not been stamped with the inspector's (Y) stamp per ESD 243. Restraint No. 1047-14Rt had two welds which were not stamped with the welder's ID. One weld process HOH sheet indicated ~~X~~U T inspection but the weld was not stamped to reflect this. The corrective action recommended by PG&E was for all welders and inspectors to be instructed on the requirements for stamping and inspecting completed welds.

This problem of weld identification and documentation was not an isolated case but effected almost all rupture restraints erected up to this time. The problem was not just failure of welders to stamp their welds and inspectors to record the information on the process sheets. On many of the restraint erections there were joint connections involving as many as 3 to 10 or more welded connections. All the welded connections in the joint were given a single identification number. Then later it was decided that each welded connection had to be identified, so the process sheets were amended to read FW number A-~~1~~J or however many joints were involved. But the process sheet did not necessarily reflect the correct welder for each welded joint. Then to compound the problem, Kellogg would initiate a stamp program as part of their corrective action to the PG&E audit.

Kellogg's (Pullman) response to the audit, dated 12-1-75 was that a field inspector had been assigned to review all

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field records against completed work to assure correlation between the two. Field records used were "Daily Inspection Logs" and process sheets. These records did not record what type of weld was made (fillet, groove, etc.). So the field inspector could not accurately match field records with welds and subsequently many welds were misidentified and misstamped. This problem of weld identification would resurface on several future occasions and reveal that welds were not correctly identified and stamped.

The problem of properly filling out QA documentation was a continuing problem. The QA/QC Manager issued an Interoffice Correspondence on 4/14/76 giving instructions on how to make changes to QA documents. "White out" was not to be used to correct entries. A line through the incorrect entry and a new entry for the correct information was directed. All changes had to be initialed and dated.

On 4/22/76 an Interoffice Correspondence issued to all field inspectors gave instructions concerning the proper filling out of Process sheets. It stated that process sheets will be signed and dated in each required block. Lines drawn down the column with initial and date at the top and bottom is not accepted. Any changes including N/A on the process sheet will be initialed. If a weld is cut out you will state the reason, initial and date. QA documents would be of little value if the documents were not filled out properly or the information provided did not include all data or provide accurate data. This problem would keep reoccuring.

On June 4, 1976, PG&E Engineering Research sent a letter NOH

to PG&E management at Diablo Canyon Plant concerning an investigation into the ~~cause~~ use of cracking adjacent to beam-to-column flange welds in Unit 1 pipe rupture restraints (DR#3158). A failure analysis was performed on a portion of cracked welds and residual stress measurements were made on the beam the welds came from as well as in areas adjacent to where the cracks were found. The results of these investigations were:

1. The fracture is brittle in nature.
2. The fracture results from flame cutting of the welding relief hole in the weld.
3. There are high, up to yield stress level, residual stresses in the vicinity of the beam-to-column weld joints. These stresses are a result of the beam-to-column weld.
4. Higher residual stresses, and cracks, appear to be associated with wide, greater than 3/4" wide weld passes.

The letter stated that the failures appear to be the result of a number of minor materials property, fabrication details, and construction sequence details that combined to cause these cracks. The letter then gave recommendations for repair and modification of welding and manufacturing procedures to to alleviate these problems. These recommendations were:

1. Preheat before all thermal cutting operations according to the welding preheat schedule for the thickness of material being cut.

2. Remove, by grinding or other mechanical means, a minimum of 1/16 inch from all flame cut or arc gouged surfaces not to be incorporated in the weld.
3. The welding procedure should be modified to limit the weld bead width to 5/8" maximum°F or 2½" and thicker material in beam-to-column joints and other restrainted joints, the minimum preheat temperature should be raised to 300° F, and a maximum interpass temperature of 800° F should be imposed.

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4. Where possible the weld joint detail should be modified to reduce the volume of weld metal deposited. This can be accomplished by using a narrower groove, a double-V weld preparation, or both, instead of the 45 single-V weld preparation presently used.

Weld Code 7/8, a primary R.R. welding procedure, did not include in its weld procedure Specifications (WPS), joint details for a double V weld. But Code 7/8 would now be used to make double V groove welds in nonconformance to the WPS.

Revision #7 to ESD 243, dated 6-10-76 was a direct result of the PG&E investigation of a cracking problem on rupture restraint HGR 126, Unit 1 turbine Building. The revision added tabular data for preheat and interpass temperature requirements during welding and thermal cutting. It added a requirement to clean by ~~gunsling~~ GRINDING a minimum of 1/16" from thermal cut surfaces which were not to be incorporated into a weld. The revision added minimal guidelines to dimension weld access relief holes.

Prior to this time a specific preheat and interpass temperature was not included in ESD 243. The weld procedure specification was the control document, however, reference to ESD 243 was not included in the weld specification until October 1976.

There were four weld procedure specifications for rupture restraints with weld Code 7/8, the main procedure. Weld code 7/8 was originally two separate procedures identified as weld Code 7 and weld Code 8. These procedures were approved on 11/25/69. Both codes were for welding carbon steel pipe using E7018 shielded metal arch welding process. On 12-10-73, the codes were combined and added carbon steel plate to the specifications. Weld code 7/8 was identified for use on HGR

rupture restraints groove and fillet welds. Preheat requirements were changed to 50° F minimum with 175° F minimum for material that had a carbon content in excess of 0.30% and 1" thickness. Interpass temperature was indicated to be 50° F minimum. A 10-15-76 revision to weld Code 7/8 stated "See ESD 243 for AWS Welding", referring to structural steel welding (which rupture restraints was). This revision also stated that the procedure was qualified to allow welding of unlimited thickness on structural members under AWS requirements.

Weld Code 92/93 was similar to weld code 7/8 in that some of the welding techniques were the same. Code 92/93 was qualified for open butt welding but was used to weld groove welds with a backing strip. This weld code was used during peak workload periods because there was no requirement to re-qualify welding personnel. A problem would arise with process sheets referencing Code 7/8 but ~~not~~ ROD requisition referencing Code 92/93. Production and QC substituted Code 92/93 for Code 7/8 to expedite the construction process.

Weld Code 205 was developed and approved for flux cored arc welding of carbon steel to carbon steel for structural steel only.

Weld Code 206 was developed and approved for gas metal arc welding carbon steel to carbon steel for structural steel only.

Kellogg (Pullman) established ESD 219 for "weld procedure monitoring"in 1973. This procedure was originally established to monitor Class I pipe welding. Revision 5, dated 6-17-76, added rupture restraint welding as Class I welding and directed that ESD 243 would be the applicable procedure for preheat monitoring

for structural welding. ESD 219 also stated that Welders and inspectors shall monitor the interpass temperature of all Class I welds for compliance with the weld procedure. Paragraph 3.3 of ESD 219 concerning "Pre-Heat temperature" states "the minimum pre-heat temperature on this project is 50° F. If the air or metal temperature is below 50° F, pre-heating is required. Air temperature shall be monitored by wall thermometers." Pullman Internal Audit report #80, date of 12-24-80, found there were no wall thermometers evident in the powerhouse which could be used to monitor air temperature to determine if pre- heating was required. Corrective action was to order thermometers and, upon receiving them to implement ESD 219.3.3.

Nine months later on 9-22-81, Internal Audit Report #94 would report that wall thermometers were received by Pullman QC, calibrated but never issued to the field for implementation of ESD 219.3.3. It was not until November 1981 that wall thermometers were placed in the power house to monitor air temperature. It took 8 years for the requirements of ESD 219.2.2 to be implemented. It took 11 months after the noncompliance was found before corrective action was actually implemented. In my professional opinion, this was inadequate implementation of Quality Assurance requirements.

From ~~7-23-76~~ 3-23-76 to 7-20-78, a total of twenty four discrepancy reports were generated which involved cracking in Pipe Rupture Restraints. On 7-22-76, ESD 243 was revised to authorize field modification of weld joint detail during weld repairs and/or new weld preps. This was done to reduce the volume of weld metal deposited,

i.e. narrower grooves, double bevel grooves versus single bevel grooves, thereby helping resolve the weld cracking problem.

The continuing problem of weld cracking raised the question of when the final visual exam should take place. On 9-9-76, an IOC was issued to all rupture restraint inspectors instructing them to sign process sheet step #5 - weld complete (not a QC hold point) when welding was complete. Step #6 - Final Visual, was not to be signed until the weld had cooled to ambient temperatures and then the inspector was to check and see that the weld area was clean of slag, scale and smoke, and that it was smooth for UT exam. The inspector was then to complete his final inspection and sign the process sheet. This would help inspectors to more readily detect cracks in the welds.

On 10-7-76, DR#3295 and PG&E DR#M-3192 would report 1200 welds to "rupture restraint structure members" without the application of the required preheat. The welds involved attachments such as temporary lifting eyes, nuts and bolts, shims, rod eyes and hinges. The weld sizes ranged from single pass 1/8" fillets to 1/2" fillets. Base material thickness, which governed preheat requirements, ranged from 3/4" to 6". There were no process sheets issued to control the welding or any other QA/QC documentation. DR#3295 required that these welds be examined by magnetic particle testing to determine if they were acceptable. Three hundred fourteen welds were examined and found acceptable. Based on the acceptance of these welds, the remaining welds were accepted as is without being tested.

Up to August 1977, there are no records of Nuclear Regulatory Commission Inspectors involving themselves specifically with rupture restraints. Then on 8-2-77 an NRC inspector made an inspection of the Bent 9 rupture restraint on Unit I piperack. The inspector found what he believed to be undercut on FW40. The inspector also found documentation problems. He found on process sheets for FW40 and 41 that the final inspection was dated one day prior to the fit up of the weld joints. He also found another process sheet with the final inspection hold point "N/A" by Kellogg Inspector Mullis.

Kellogg (Pullman) issued DR#3449 to report and resolve the findings of the NRC inspector. The following corrective action was taken:

1. FW40 had weld metal added to fill the low area at the weld edge.
2. FW 40 and 41 were reinspected and the dates corrected. A review of rupture restraint process sheets was performed and a random reinspection of a minimum of 20% of all welds accepted by Inspector Lindell was performed.
3. All process sheets reviewed in #2 above which had "N/A" inserted in inspection points were reinspected and if required, repairs made. (This action infers that Lindell was more suspected of N/Aing process sheet operations than Mullis who was caught N/Aing by the NRC.)
4. Errors found in stamping of welds during reinspection were to be restamped to correspond with applicable rod requisitions and process sheet documentations. This would involve 43 welds on Bent 4.

Inspector Lindell had not been employed by Kellogg (Pullman) since 9-3-76 so no action was taken against him. Inspector Mullis had no explanation for entering "N/A" in the process sheets. Mullis was then fired for failure to comply with established procedure.

On 9-12-77, an IOC was issued by the QA/QC Manager to report on meeting with Pullman Power Products (Kellogg) field inspectors

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on August 8 and 9, 1977. These meetings pointed out that field inspectors did not have the authority to N/A inspection points. They were to advise welders and fitters of the hold point requirements and to perform required inspections as soon as possible after notification. Also discussed was the termination of Inspector Mullis, the reason for that termination and the work required to correct the situation.

By this Pullman (Kellogg) showed the NRC that the company had implemented corrective action for QC inspector's failures to comply with procedures. Inspector Mullis was a scapegoat to cover up bigger problems.

Inspector Mullis cannot be excused for N/Aing a final inspection point, but what about extenuating circumstances? Inspector Mullis was doing more than just QC inspection work. In the Unit #1 GE, GW and piperack areas, Inspector Mullis was performing engineering and drafting work with the approval of Pullman (Kellogg) QA/QC Management and Production Management.

An Interoffice Correspondence dated 10-23-75 from the QA/QC Manager had directed QC inspectors to assume engineering duties of telling production personnel to use more heat than required to make welds and to tell production personnel how to make their welds by recommending welding sequences which would induce less stress in the welds. Inspector Mullis assumed the engineering duties. This instruction was in direct contradiction to earlier QA/QC correspondence dated 1-31-74 which stated inspectors were not to give work instructions to foremen and pipefitters, and to correspondence dated 6-17-74 which stated Quality Assurance was not an engineering service. Why was it

necessary for QC inspectors to perform engineering duties? There were field engineers on the jobsite, but their main concern was the erection of piping and hangers. They gave little if any engineering direction to the erection of rupture restraints. Rupture restraints had low engineering priority because Pullman (Kellogg) management had instructed inspectors like Mullis to provide the engineering services needed. After the NRC incident engineering would take a more active role.

In addition to performing QC and engineering duties, Inspector Mullis did As-Built drawings of the rupture restraints he worked on. These drawings showed the as-built field conditions of the rupture restraint as well as numbers assigned to each welded connection for documentation identification purposes. Inspector Mullis drew many of these as-built drawings and they are the basis for the current rupture restraint documentation packages field layout drawings.

Inspector Mullis was fired for NAing an inspection point, yet QA/QC Management on two occasions stated it was okay for an inspector to do so. Interoffice Correspondence dated 3-27-74 (attachment 3A) stated "any inspection points that do not apply to a particular support shall be noted with a "N/A"." Interoffice Correspondence dated 4-22-76 (~~attachment 12D~~ H6H) stated "any changes including N/A on the process sheet will be initialed..." NAing inspection points on process sheets was an accepted practice on supports which inspector Mullis decided to implement in rupture restraints.

So the first NRC audit of rupture restraints revealed documentation problems and field welding problems but failed to recognize a major breakdown in the QA program, quality control inspectors H6H

doing engineering and drafting work.

Inspector Mullis assumed duties and responsibilities outside his assigned QC functions. Pullman (Kellogg) management knew and approved of it until Mullis was caught by the NRC. Maybe the reason Inspector Mullis NAed the inspection point was that he was so busy doing engineering and drafting that he didn't have time for quality control.

It should be noted that on 5-17-77 an interoffice correspondence issued by the QA/QC Manager stated that Inspector Mullis "through daily demonstrations meets the requirements of SNT-TC-IA..., ESD 235, ESD 237 and KFP6 "Evidence of Continuing Satisfactory Performance"." Two and a half months later he was fired for failure to comply with established procedures.

ESD 243 was revised on 1-19-78 to add the requirements for the Field Engineer to review all drawings and initiate all Field Process sheets. It added a requirement for QA review of process sheets prior to issue for work and revised the field process sheet to include the weld symbol, thickness of material and QA review entries.

On 7-20-78, DR#3683 reported a lamellar tear which opened during repair of a weld in the Unit #1 piperack. Subsequent NDE and metallurgical studies by PG&E revealed a generic problem associated with highly restrained joints. On 10-3-78, PG&E issued non-conformance report #DC1-78-RM-008 which identified that welds for pipe rupture restraints in materials greater than 1½" thick had developed cracks.

On 3-23-79, PG&E issued non-conformance report #DC1-79-RM-006,

which identified numerous welds that developed cracks after completion of welding and final examination. On 5-7-79, NCR# DC1-79-RM-007 was issued, which identified that further investigation had found rejectable linear indications in other rupture restraint weld joints. On 6-6-79 PG&E issued NCR # DC1-79-RM-010, which identified that nondestructive and destructive testing had found the existance of rejectable defects in field welds. This NCR resulted in an extensive program of investigation, evaluation and repair of rupture restraint welds. On 6-21-79 PG&E issued NCR # DC2-79-RM-011 which identified welds in Unit #1 with rejectable defects, and that the same or similar conditions may exist in Unit II.

The major problems causing rupture restraint weld cracking as determined by PG&E and Pullman were:

1. Joint Design
   A. Massive weldments, 5" deep x 4-5/8" wide with 45° single bevel grooves that would shrink unrestrained about ½" in a transverse direction, instead were totally restrained by high columns and beams. All potential shrinkage is transformed into residual stress and/or cracks.
   b. Highly restrained joints with heavy sections attached to relatively thin sections. Lateral reinforcement stiffers, 2" to 3" gusset plates, were welded exactly opposite, both pulling on ½" to 3/4" thick webs and flanges.
   c. PG&E Department of Engineering Research would develop their investigation around four additional welded connection joints classified by degree of restraint.

2. Base Material
   a. Almost all cracks originated as lamellar tears in A441 and A588 steels used in highly restrained joints.
   b. Some materials had excessive rolled laminations.
   c. PG&E supplied base material that was inadequately identified prior to implementation of QA verification of base material.
   d. Low melting point alloys formed with copper (in A441) and sulfides triggering tears.

3. Indiscriminate Material Removal
   a. Large destructive test samples were removed.
   b. Some sections were essentially destroyed chasing cracks. [illegible] given to how removal stresses affect

other joints in the same structure.

4. Inadequate Preheat and Interpass Temperature Control
   a. Material type being welded was not included as an element of planning for rupture restraint work. As a result, sufficient controls were not established for preheat and interpass temperatures.
   b. Ambiguous terms and phrases were copied from PG&E specifications, with inadequate implementation of AWS code requirements regarding preheat and interpass temperatures.

A major crack repair program would be initiated in both Units of the power plant in March of 1979. The Pullman Field QA/QC Manager stated in an IOC dated 8-28-79 that an estimated 40,000 man hours had been expended to date and that only approximately 50% of the work in Unit I was completed. Rework would continue in Unit I & II until 1981/1982.

The rupture restraint crack repair program would result in major changes in the Pullman ~~instruction~~ CONSTRUCTION program. In May 1979, Pullman would issue a special welding procedure to make the weld repairs. Welding technique Specification #AWS1-1 was formulated to clarify the technique for application of weld code 7/8 procedure as applied to AWS welding only. AWS1-1 and other similar techniques were based on PG&E recommended procedures ~~with~~ BASED ON their analysis of the cracking problems. The technique gave very detailed parameters for making the crack repair welds. But these techniques were not applied to the general rupture restraint construction program. Weld Code 7/8 would continue to be the primary welding procedure for general RR construction. Prior to 1979 rupture restraint welders had been qualified to the ACME Section IX code. As a result of the crack repair program welders would now be required to qualify ~~for~~ TO the AWS Code requirements.

A number of changes were made concerning the NDE requirements for rupture restraints. C.S. #8833XR was revised to require that all completed full penetration and partial penetration welds and fillet weld ¼" and larger shall be magnetic particle inspected. Pullman would prepare a QA Instruction #143 to implement these requirements which would eventually be incorporated into ESD243. When the instruction was submitted to the PG&E Resident Mechanical Engineer for his approval he would amend the instruction to read "all partial penetration welds ¼" and larger" would require magnetic particle examination. Pullman would implement the PG&E revised QAI#143 and for the next two years would perform NDE which did not comply with the revised C.S. #8833XR requirements. In August 1981, PG&E recognized its error and required QAI#143 to be revised to include all partial penetration welds to be magnetic particle examined. A reinspection program was initiated to identify the welds not magnetic particle tested.

PG&E provided to Pullman the NDE procedures to be used for magnetic particle testing. However, Pullman Internal Audit #LXXVII, dated 9-25-80 identified that PG&E had provided conflicting procedures for Pullman to use. PG&E had directed that all rupture restraint magnetic particle exams were to be performed to PG&E's DER NDE procedure #3212. This procedure stated that the preferred examination was the Yoke method per PG&E DER NDE procedure #3204. But PG&E had provided Pullman with a DER NDE procedure #3205 which was a prod. method. PG&E had stated one method was to be used but had provided a procedure for a different method. As a result of the Internal Audit, PG&E would direct Pullman to use the Prod. method.

PG&E would direct Pullman to use a PG&E ultrasonic proce-

dure #3523 to examine only full penetration welds 9/16" and greater effective throughout. This would not comply with C.S. #8833XR requirements to ultrasonically inspect all connections utilizing full penetrations welds. This conflict between C.S. #8833XR requirements and PG&E UT procedure would be identified in Pullman's Unscheduled Internal Audit #29, dated July 1982, but both Pullman and PG&E refused to address the non-conformance to Contract Specification requirements. Not until 1984 when allegations of non-conformance to contract UT requirements were made to the Nuclear Regulatory Commission would PG&E revise C.S. #8833XR.

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In 1982 I identified in Pullman's Internal Audit #101 that ESD234 Ultrasonic procedure had not been properly qualified. ESD234 had been used prior to 1979 to examine all full penetration Rupture Restraint welds. IA#101 identified that ESD234 did not have Procedure Qualification Records documenting a Procedure Qualification Test. C.S.8833XR required all procedures (including NDE) to have qualification records. This problem may have contributed to the weld cracking problems.

The Rupture Restraint ~~Tank~~ crack Repair Program was not the only major problem with Pipe Rupture Restraints. There would be a significant Quality Assurance breakdown identified in the Rupture Restraint Construction Program. By 1977 PG&E was concerned that Pullman was experiencing difficulties in performing work, that was constantly changing per requirements at the direction of PG&E, to qualify standards that would allow PG&E to enter into the later hearings with the NRC with complete confidence that Units I and II would be acceptable for licensing. PG&E requested Pullman to have an independent audit performed of its QA Program. Pullman contracted Nuclear Services Corporation of Campbell, Calif. to perform this audit.

From August 22 to September 20, 1977, Nuclear Services Corp. audited the Pullman Construction Program at the Diablo Canyon job site. The basic conclusion reached by NSC was that the Pullman QA Program did not meet 10CFR50 Appendix Requirements. NSC summarizes Pullman's problems as follows:

1. Prior to early 1974, there is little evidence available to verify the adequacy of the work performed. The available evidence indicates that only a rudimentary quality control program existed and that control over the production organization was minimal. NSC concluded that there was no confidence that welding done prior to early 1974 was performed in accordance with welding specification requirements.

2.From early 1974 to late 1974, there is evidence available to verify the adequacy of the work performed. The available evidence indicates that control was achieved of the materials control program and the welding control program.

3. From late 1974 to the present, an increasing amount of documentation and records has been generated to verify the adequacy of the work performed. The available evidence demonstrated that an increasingly more stringent quality program has been placed into effect and increasing greater control of the work effort has been achieved. However, the present program and controls still do not meet 10CFR50 Appendix B requirements.

As a result of the 1977 Nuclear Service Corp. audit, PG&E's QA Department would perform Audit #80422, issued 6-13-78. PG&E's conclusion was that the QA Program implemented by Pullman essentially fulfilled contract requirements and meets requirements of the ASME Boiler and Pressure Vessel Code, 1971 edition. PG&E stated that the 1971 code was consistent with the requirements of 10CFR50 Appendix B. What PG&E and Pullman failed to recognize was that only Pullman's Piping Construction program was based on the ASME Code QA requirements. The Pipe Support and Pipe Rupture Restraint QA programs were not based on a ~~material~~ NATIONAL code or standard and there was no commitment to 10CFR50, Appendix B for these programs.

One of PG&E's audit findings was that Pullman audits performed to verify Unit II hardware items in early 1978 did not effectively evaluate the quality of their work. Pullman had audited 122 hangers, restraints, and snubbers and 77 isometric drawing packages and found no discrepencies. Yet when PG&E re-audited half of the items inspected by Pullman, several discrepencies were noted. The result was that PG&E ordered Pullman's corporate staff to perfrom another audit in the summer of1978.

The PG&E Audit #80422 would generate two Non-conformance Reports. NCR#DC-78-RM-004 identified that Pullman's QA Program was not adequately defined. There were procedures which implemented QA requirements of the contract but are not identified as part of the program and revisions are not controlled by the program. PG&E found that it was not clear which manuals and procedures were applicable to specific activities. The corrective action was to write a program discription that would clearly identify the documents to be considered part of the total quality assurance program and establish the heirarchy of the documents.

The second part of the NCR addressed Pullman's inadequate corporate and Internal Audit Program. The scope of both types of audits had not been established, and there was no detailed schedule developed to show that all aspects of the program had been audited. Audit records indicated that all aspects of the program had not been audited. No management audits had been performed on pipe supports and rupture restraints. An unofficial, unapproved internal audit schedule existed, but it had not been followed consistantly and few ESD's appeared ~~with~~ on the schedule.

A second NCR #DC-78-RM-005 was also issued. P.G.&E's review of prodedures and work in progress indicated that Quality Control inspections independence from scheduling and production pressures was not ~~assumed~~ assured by the program as written. Procedures did not clearly indicate that it was the Productions Department's responsibility to read and use the process sheet insuring that steps were performed in the required sequence and that hold points were observed.

Four Minor Variation Reports would be issued to deal with specific discrepancies. It should be noted that P.G. & E. identified some Pullman inspectors who were not qualified to ANSI N452.6 and recommended that the Pullman inspector certification card should be amended to eliminate the claims that inspectors are qualified to ANSI N45.2.6, or inspectors should be qualified in accordance with its requirements.

In November 1978 an IOC from Pullman's Corporate Senior QA Engineer to the Director of QA confirmed P.G.&E.'s audit findings concerning Pullman's Corporate audit program. The IOC stated that the "Diablo Canyon Project has been audited extensively only in hardware areas. The entire program has not been evaluated." The IOC would also state, "In the past, Pullman Power Products did not conduct audits or practices to ASME or 10 CFR 50, Appendix B."

Also in November 1978 Pullman implemented corrective action to NCR#DC-78-RM-004 by issuing a QA Program Description. Pullman deleted the Pipe Support/Pipe Rupture Restraint QA Manual from its QA Program. In its place there would only be one QA Manual. The QA Program Description stated, "The basic document for the QA Program is the Pullman Power Products QA Manual. This manual was written to conform to the requirements of ASME Section III 1971 for piping fabrication and installation. Many of the requirements of the piping manual such as: Organization, NDE, Calibration, Weld Rod Control, ~~Part~~ Post Weld heat treatment, Welders qualification and audits are applicable to other work. Not all the requirements of the piping manual are applicable to the full scope of work. Where these exceptions exist they are indicated by subtier documents such as separate QA plans, ESD's or QA instruction."

The QA Program Description listed a number of subtier documents as applicable to Pipe Supports and Pipe Rupture Restraints. But nowhere in the QA Program Discription is there a specific list of the piping manual requirements which are applicable to Supports and Restraints. The Discription states that many of the requirements of the piping manual are applicable to other work but it fails to specify which requirement for which work. Also there is no committment in the QA Program Description to 10 CFR 50 Appendix B for the other work areas which fall outside the scope of the ASME Section III QA Manual. The result is that to this day Pipe Rupture Restraints still do not have an adequately defined QA Program which is based ~~on~~ OR ANY OTHER NATIONAL CODE OR STANDARD 10 CFR 50, Appendix B.

As a result ~~of~~ the P.G.& E. QA Department Audit #80422, dated 6/13/78, which found that Pullman's Corporate audit performed in early 1978 "did not effectively evaluate the quality of their work", Pullman was required by P.G. & E. to send additional staff to the site to perform "an overall assessment of the situation"

to determine whether additional reinspection should be performed and the scope thereof. Pullman's Corporate Management performed the site audit from 7/10 to 7/20/78. The purpose of Audit #7177-3-78 was to verify and evaluate field initiated corrective action that resulted from the Nuclear Service Corporation Audit of Pullman, to verify the adequacy of the Quality Assurance Program implemented and the quality of hardware installed, primarily in Unit 1.

Pullman's Audit #7177-3-78 would result in 43 Audit Action Requests requiring corrective action to improve the adequacy of the QA Program. Criterion I of the audit would verify 24 of the Nuclear Service Corporation Audit findings that had been or would require corrective action. There findings included:

1. Description of individual ~~position~~ POSITION responsibilities are inadequate.
2. Hydrostatic testing interface between P.G.&E. and PPP lacks adequate control.
3. Interface between PPP Corporate Organization and Field Organization is not described with respect to Field Purchases and Corporate QA Auditing of these suppliers.
4. Indoctrination and training program requirements for personnel involved in quality related activities are inadequate.
5. QA Document Control Procedure does not have provisions for training and familiarity in the implementation of procedures.
6. Activities affecting quality are not described in procedures.
7. No control exercised over ESD procedures
8. No procedure for control of QA instructions.
9. Procedure detailing review of Hangers and Pipe Supports is lacking.
10. No procedure exists prohibiting the changing or alteration of key documents.
11. No procedure specifying who is responsible for 90 Day Welders Log.
12. Random sampling of welding in process not documented.
13. There is no procedure for preheating of weld joints.

14. ESD 231 does not provide enough information for HOT and COLD bending small bore pipe.

15. Lack of identity of Hydrostatic and heat-treated guages with applicable inspection reports.

16. ESD 213 does not contain provisions for reporting pre and post calibration values.

17. Hydrostatic Test Procedures did not cross reference each other.

18. No procedure for filing, storing and protection of records.

19. No procedure or checklist to define scope of field conducted internal audits.

Criterion II of Audit 7177-3-78 reported a significant problem in the evaluation of the Piping IR's. Information referenced on the Field Installation Instruction (Drawings) did not agree with information published on the Process Sheets.

Criterion III of Audit 7177-3-78 reported numerous individual descrepancies of Hanger assemblies but did not report any program deficiencies.

Criterion IV dealt with Rupture Restraints. Of the 43 Audit Action Request generated by Audit 7177-3-78, 20 were written against Rupture Restraints. A significant QA Program deficiency was identified in the Rupture Restraint construction program. The corporate auditor concluded:

> "The rupture restraints documentation package cannot be used for an adequate audit. It was pointed out that additional drawings are available. The only way some of these restraints could have been installed is by the referenced design drawings, however we were informed by site personnel that other drawings exist that could effect the final installation. These additional drawings are not referenced within the RR package. It is obvious, and site personnel agree, that this is a definite problem in regards to drawing referencing. QA site personnel also have problems getting documentation to properly match final erection due to lack of "as built" drawings. It was pointed out that there is a lack of proper interface between P.G. & E. and site PP/QA."

Criteria V of Audit 7177-3-78 was Hanger Drawing Control and As Builting Program, and the audit concluded there is evidence that adequate control is being exercised.

Criterian VI of the audit was a review of Non-Conformance Reports and concluded that there was evidence that the recommended ~~disposition~~ disposition of the DR"S were "generally" followed with the necessary documentation developed to support the nature of the work performed.

Criterian VII concerned Management Audits and found that audits were not performed in accordance with the QA Program requirements of every six months.

Audit 7177-3-78 concluded that the area of main concern was associated with Rupture Restraint. It was recommended that a Field Inspection Program be initiated in the area of Rupture Restraints for both Unit I and II. A.A. Eck, who was the ~~head~~ auditor for this audit, concluded that the "Quality Assurance Program as implemented basically meets the ASME ~~Boiler~~ BoiLER and Pressure Vessel Code Requirements, 1971 edition."

Although significant QA problems were identified in the Rupture Restraint Construction Program, Pullman Management claimed the QA Program as implemented basically meets the ASME code requirements. A possible reason for this could have been the fact that piping, which was based on the ASME code QA requirements, had no significant problems identified. Yet rupture restraints, which were not based on the ASME code, or 10 CFR 50 Appendix B or ANSI N45.2 QA requirement, had significant QA problems. It was their absence of committment to the federal code and national standards which resulted in a deficient QA program for Rupture Restraint.

P.G. & E. now was acutely aware that Pullman's pipe rupture restraint program had been out of control. On 10/26/78, P. G. & E. issued Nonconformance Report #DCl-78-RM-009. This NCR was concerned withPullman's documentation for the erection and inspection of rupture restraints inside Containment I. The NCR would identify: "1. Documentation shows work complete, correct and inspected. Work is not correct. 2. There is physical evidence of work but inspection records are incomplete or nonexistent."

But P.G. & E. would find that the problem extended far beyond Containment I and documentation problems. NCR#DCI-78-RM-009

was cancelled and in its place P.G. & E. issued NCR# DCI-79-RM-003 on 1/24/79 for all Unit I Rupture Restraint work, and NCR# DC2-80-RM-002 on 11/19/80 for all Unit II Rupture Restraint Work. Both NCR's #DCI-79-RM-003 and #DC2-80-RM-002 would identify:

"1.a. Documentation shows acceptable bolted connections. However, there are cases of out of tolerance gaps existing under base plates, nuts not bearing against splice plates properly and nut not engaged per requirements.

b. Documentation shows acceptable welded connections. However, there are cases of materials and welds not conforming to the specifications.

c. There are bolts that have "torque seal" which indicates tensioning and inspection, however, inspection records do not exist."

PG&E would identify the cause of the Nonconformances to be the fact that "Pullman Power Products Rupture Restraint Program has had inadequate design change control, inspection performance and control." Another cause not identified by PG&E was the fact that Pullman's Rupture Restraint construction program was not committed to the QA requirements of the ASME, 10CFR50 Appendix B or ANSI ~~N45.2~~ N45.2 codes, the result being a totally inadequate Quality Assurance Program for the erection and inspection of Rupture Restraints. NOH

The corrective action required by PG&E was that "Pullman shall perform a documented inspection of all bolted and welded connections and applicable documentation, required by the Specification, as set forth in approved contractors ESD's, in order to:

1. Identify connections which do not conform to specification requirements and
2. identify connections which do ~~not~~ HAVE require documentation."

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Identified deficient conditions would be resolved per the NCR's. It should be noted that PG&E did not report these NCR's to the Nuclear Regulatory Commision as a 10CFR Part 21 Reportable item. NOH NOH

Pullman would issue on 2/16/79, ESD 273 "QA Final Walkdown and Documentation Review-Rupture Restraints" as the procedure to direct the reinspection of Rupture Restraint work. The final walkdown

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inspection and documentation review commenced shortly thereafter in Unit I and continued into the summer of 1980.

Unit I Final Walkdown Inspections were performed in non-compliance to ESD 273 and other procedure requirements. Pullman Deficient Condition Notice (DCN's) #476-027 (4/1/80), #476-028 (4/21/80) and #476-029 (5/1/80) identified that Final QA Walkdown Inspections did not conform to QA instructions #137 and #148, which stated that ESD 268 and ESD 273 would be used to identify and document dificiencies discovered during final ~~Landware~~ HARD walkdown. HOH The following ESD 273 and ESD 268 procedure requirements were not implemented during the Unit I Final Walkdown inspections.

1. QC Inspectors did not initiate Deficient Condition Notices during the walkdown process but merely noted dificiencies on a QC/Engineering Walkdown Sheet, (ESD 273). HOH
2. A D.C.N. was not initiated for <u>each</u> dificient condition detected. Deficient conditions were taken from the QC/Engineering Walkdown sheet and listed on a punch list and then assigned a single DCN number. Representative Punch list DCN#381-215 for construction induced defects, had 98 separate deficient conditions listed. This did not conform to ESD 273 procedure requiring a DCN for <u>each</u> dificient condition noted. HOH
3. ESD 273 required that "documentation of all deficient conditions noted shall be in accordance with ESD268". The following ESD 268 procedures were not implemented during Final Walkdown Inspections of Unit I Rupture Restraints. HOH

   A. Field QC Inspectors did not generate DCN's as required by ESD 268. Instead QC Inspectors noted deficiencies on QC/Eng. Walkdown Sheets.

   B. ESD 268 required that "each DCN shall be assigned a number by the Field QC Inspector concerned." This was not done. Engineering reviewed the QC/Eng. Walkdown sheet and then requested a DCN number from the QC Inspector Supervisor, not ~~an~~ the Field QC Inspector noting the deficient condition. The orginator was squeezed out of the picture. HOH

HOH