UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of TEXAS UTILITIES ELECTRIC COMPANY, et al. (Comanche Peak Steam Electric Station, Units 1 and 2)	Docket Nos. 50-445 and 50-446 (Application for an Operating License)

AFFIDAVIT OF CASE WITNESS
JACK DOYLE

The purpose of this affidavit is to address the applicability of statistical sampling to CPSES, based primarily on what has been learned through my review and analysis of pipe supports at Comanche Peak but with clear implications for the entire statistical sampling program proposed by Applicants for CPSES by the Comanche Peak Response Team (CPRT), Stone & Webster, etc.

THE QUESTION

The Applicants would apparently have us address only one issue: Is the methodology as indicated in the March 28, 1986, Ropes and Gray transmittal an appropriate procedure? The question more accurately is not whether or not the procedure is correct, but rather **is the application proper**?

In reference to the application of statistical probabilities to the search for errors in design and construction at CPSES, one must bear in mind what the underlying purpose and intent of statistical probabilities are. For example:

1. <u>To establish a level of confidence in the postulated probabilities</u>: for instance, a 95% level of confidence indicating that in 19 out of 20 chances the probability is as determined or less, and one chance in 20 that it is greater. In short, the probability would indicate that flaws exist whether or not a single flaw is found in the sample. Beyond this, the level of confidence is 1 out of 20 that the problem is more extensive than assumed.

2. <u>To determine the defects within a sample of significant size in order to project the probability of defects within a significantly larger population</u>.

3. <u>To improve receiving inspection, maintenance cycling, and safety</u>; this is most often the purpose of such techniques (inspecting a portion of the population to estimate the probable quality to be anticipated in each such population).

(a) In the case of receiving inspection, considerations which govern the sample size and the confidence level are purely monetary; that is, what risk am I willing to assume to avoid the cost of inspecting each article of a shipment?

(b) In the area of maintenance, statistical sampling can serve to establish the time table for preventative maintenance.

(c) Safety can be improved by determining the time frame for specific inspections or the discovery of potential trouble areas for safety-critical items before the problems occur.

4. <u>Trending to determine the probability of occurrence of the unaccounted for or unpredictable problem</u> (for example, the O-rings in NASA's Challenger seals) is another area open to statistical analysis.

In all of the applications listed above, **the paramount purpose is to solve problems** -- not to prove that problems are acceptable or to discount their significance. The art of statistical sampling is utilized to balance the risk vs. the consequence of a required action, by establishing a time frame for action or a sample size for inspection.

Not to dwell on sampling procedures, but a few of the pitfalls of the art of statistical probabilities which are applied to design, engineering and construction are worth noting. The principle factors are: the bias of the sample and/or interpretation. Remember, there is an old cliche: There are liars, damn liars, and statistics.

1. Assume, as a hypothetical example, that the NRC wished to determine the safety of diesel generating systems in the hundred or so plants now on line and the principle item of interest was the valve between the fuel supply and the diesel engine. If the NRC were to ask two independent contractors to make a statistical analysis of the system based on their expertise, the results could be astounding.

For example, consider the following: (a) The first independent analyst found that all of the valves at the facilities were in compliance with all of the safety requirements as established in their attribute checklists. Specifically, the valves in each instance would fail in the open position, thus assuring a fuel supply to the diesel generator, and thereby insuring that the electrical system would operate the plant protection system in the event of a safe shutdown requirement. (b) For analyst number two, it was found that the same check list results arrived at a totally different interpretation of the valve which failed in the open position. This second independent analyst, evaluating his information, determined that a generic safety flaw had been identified, in that the open valve in the event of an accident represented a potential for intensification of a fire emergency in the diesel generator room. Also, in the above example, since two different conclusions may be drawn from the same criterion, an analyst could exercise his own bias relative to which point he wished to accentuate.

2. The general rule for sampling requires an unbiased sampling technique. In some instances, this methodology is improper; and design, engineering, and construction are but three examples of such improper application of what might otherwise be valid statistical sampling techniques.

Assume, for example, that ten individuals are involved in the design, construction, or engineering of a thousand supports. Any sampling technique would indicate the level of confidence in the derived reliability but would fail to identify the somewhat knowledgeable individuals within the group. In the case of engineers, it is imperative that the sampling techniques be directed on a biased basis towards the individuals involved to insure that the product constructed is the product desired and, if not, which individuals are responsible, then proceed from this new benchmark in combination with resampling procedures.

APPLICABILITY OF STATISTICAL SAMPLING TECHNIQUES

As shown above, sampling techniques have a valid place in industry, but not for the purpose of evading or dismissing problems. In the current situation with CPSES, the sampling techniques employed in the reinspection effort would serve no useful function for areas not subjected to a corrective program, since in at least two specific areas (pipe supports and cable trays) CASE has already demonstrated that major defects exist and Applicants are (to say the least) prone to downplay the allegations. Beyond this, Applicants have not demonstrated that they are qualified to generate a list of attributes which would satisfy the 95/5 criterion. (<u>See</u> previous discussions in CASE pleadings, such as CASE's First Critique of Applicants' Comanche Peak Response Team (CPRT) Plan, sent to the Board under cover letter of 8/14/85.)

There are several features of this principle (statistical sampling) which are not applicable to CPSES or any other like situation:

1. The concept of statistical sampling to qualify a population is based on <u>an idealized environment</u>. That is, the attempt to create a conforming population is the desire of, and within the capability of, the producer. The purchaser also has the desire and the ability to perform an unbiased sampling approach. And ultimately it must be determined whether or not the applicability of the technique is proper.

As a case in point, the aircraft industry has the desire to produce a failsafe product for several reasons: First, to attain a name on the world market for a safe product; second, to avoid product malfunction within the anticipated lifetime of the aircraft; but third, and most important, to protect the life of the traveling public. To this end, oversight by the FAA and the aircraft corporation is critical. Without going into the checks and balances system required to achieve an end product which meets these goals, it is noteworthy to mention that type certification is dependent on the final test program. The final test program within the aircraft industry is unique, in that it involves the testing of the first three completed airframes to destruction. The purpose of this is to insure that all of the assumptions, etc., used to produce the various components (each previously tested individually) which are intended to resist the various flight loads (that is, static, fatigue, and dynamic loads) have achieved the results desired and that these components will not fail when assembled into the final integrated airframe.

Within the aircraft industry, to insure that there will be no failure at the final test stage, statistical sampling is utilized during the development phase for trending and other purposes. The end product for the aircraft producer must be flawless within the human capabilities of the producer. To detect flaws in assumptions or discrepancies in design is of more importance than schedule or budget. Following this program is a flight test program, and anyone within this industry who suggested that it would be prudent to replace these costly procedures with a statistical sampling technique would be immediately escorted to the nearest funny farm.

The nuclear industry has no such test programs for structures; therefore, in light of the more significant risk vs. consequence factor, it is imperative that the nuclear industry do it right before the unit becomes operational.

2. A major consideration for statistical sampling involves the parameters considered and the interpretation of the results. In the case of CPSES, both Applicants and the NRC Staff, when told of the specific faults within Unit 1, confronted the problem with three views. First, the argument was that the allegations were without merit. Second, they argued that if there were any errors, Applicants would catch them in their final vendor certification program. And finally, the NRC Staff did a statistical sample on a group of 100 supports, randomly selected from a population of 1,264 vendor certified supports, for the Staff's independent design verification in answer to CASE's allegations. The statistical analysis was based on Mil Standard 105D-63, "Sampling Procedures and Tables for Inspection By Attributes," and included only those supports which had completed Applicants' vendor certification program (i.e., the pipe support design organization had reviewed the supports and certified that each of them were

capable of resisting the design loads as determined from the architect/engineer's pipe stress analysis). The results were that, of the fifteen attributes checked, not one defect was found among the 100 supports checked. (See NRC Staff's Special Inspection Team (SIT) Inspection Report 50-445/82-26, 50-446/82-14, NRC Staff Exhibit 207, bound in following Tr. page 6289, 5/17/83, Vol. II, at pages 2, 3, 6, 7, 9, 55 through 58, especially 55 and 58.) If one were to have accepted the NRC Staff's evaluation of the status of the engineering for the pipe supports at CPSES in February of 1983, the date of the report, the plant would now be on line (although perhaps not operable).

The statistical sample as shown by the NRC exceeded what is now projected as an adequate initial sample to assure reasonable confidence that the plant has been safely designed and constructed. Statistically, the NRC Staff's findings would indicate a 97% reliability factor at a 95% level of confidence based on simple binominal distribution. The new program suggested by Applicants is similar to the program executed by the NRC Staff with one major exception. This new attempt to use the statistical sampling methodology would be executed by the Applicants themselves or at least under their control -- hardly an unbiased approach.

The intended approach by Applicants is without merit, since there are no avenues to alter reality by such application even if it were done by proper statistical sampling. And the facts are that Applicants are groping in the dark for any means to lessen the impact of the failure of large numbers of the pipe supports at CPSES and, of more consequence, to avoid uncovering another Pandora's box in what are yet unchallenged areas.

An example of this blind grasping for excuses, justifications, negating of necessity for the faulty supports, or the wild use of semantics may be noted in the following single example:

When the allegations of the problem of instability were first introduced, Applicants and the NRC Staff both took the position that for instability to be a problem, there had to be more than one support in a row which was unstable. But as was noted during the hearings, the NRC Staff has problems when inspecting areas to which they are directed. For example, in CASE Exhibit 669B (Attachment to Doyle Deposition/Testimony, accepted at Tr. 3630), Exhibits 4A, 4B, 4S, and 4Q, I referred to two unstable supports on the main steam system. In 4S and 4Q, these unstable supports were MS-1-001-005 and MS-1-001-003, which were located on the same main steam line in the Safeguards Building. The NRC Staff later stated that they had looked at each area of concern and each support that were noted in CASE Exhibits 669, 669A, and 669B (Doyle deposition/testimony and attachment, all accepted at Tr. 3630); however, the NRC Staff stated during the hearings that they saw no case with more than one unstable support in a row, even though the above-referenced supports were but two of five unstable supports in a row on that main steam line. The Applicants made no attempt to correct the record, although they were involved at that time and earlier in correcting the cluster of five unstable supports or at least four of them. (See Affidavit of CASE Witness Jack Doyle, CASE's 10/6/84 First Motion for Summary Disposition Regarding Certain Aspects of the Implementation of Applicants' Design and QA/QC for Design, pages 14 and 15.)

Another excuse offered was that the up and down stream supports would stabilize the faulty support. The problem of instability proved beyond Applicants' ability to dismiss, and the game of semantics couldn't hold up. So Applicants then offered four methods to correct the problem, all of which failed. These corrections, as the Licensing Board will recall, were: bumpers for some of the unstable supports, lugs for others, cinching up of the U-bolts for the majority, and clip angles with U-bolts for box frames to prevent frame rotation. (See Cygna's 2/19/85 letter which was attached to CASE's 2/25/85 Notification of New and Significant Information and CASE's Supplement to CASE's 10/15/84 Motions and Answer to Applicants' Motion for Summary Disposition Regarding Stability of Pipe Supports.) And as always, whenever Applicants are left with no other avenue but corrective action, they resort to their time-worn, off-the-cuff statement that the impact had no safety significance, even when the defects number in the thousands.

Finally, it seems senseless for Applicants to suggest that statistical sampling will prove anything when in fact we have several major sampling efforts from the past (as discussed in more detail in the following) aside from the NRC SIT flop (see above) -- by which it has been shown that many generic defects exist at CPSES.

First, for example, there was my original deposition and the back-up documentation which involved only some 58 supports, which has over time been proven to be accurate. These documents are the basic source of the 19 generic allegations alluded to by the NRC in the SIT Report. As a per cent of this sample of 58, we have shown that 31% are defective thus far (see pages 7 through 18 in CASE's 10/6/84 First Motion for Summary Disposition).

Second, there was the attempt by Applicants to address the stiffness allegation which was danced around for months. Finally, Applicants ordered a stiffness study. While the system and supports were selected by Applicants and the analysis was stated to be proof positive that variations in stiffness had a minimal effect on the supports and in no case led to overstressed conditions, the fact is that Applicants noted in the raw data, but failed to elaborate on the fact that a significant increase in load resulted from random variations in stiffness. With the same raw data generated by Applicants, CASE found for one system containing a single support with an actual stiffness of 1/70 of the generic stiffness, the raw data revealed the following: 20% of the supports in the system exhibited load increases of more than 25%. The greatest load increase was for a support which went from 824 lbs. to 1371 lbs. At one anchor the forces and one moment increased more than 25%; at the other anchor, all of the moments and two forces increased. The actual facts, therefore, prove that in a statistically significant portion of this sample, the loads used in the original design are non-conservative; and any reference to "no significant impact" on the allowable stress ratio is not sound engineering evaluation but pure dumb luck, because properly designed systems are not so conservatively designed that one could enjoy such margin for error. (See 10/14/83 NRC Staff Witness Dr. Chen's Affidavit on Open Items Relating to Walsh/Doyle Concerns, and its attached Applicants' 8/17/83 Additional Pipe Support Generic Stiffness Study.)

The third statistical sample compiled by Applicants involves the tests for U-bolts acting as two-way restraints. (See Applicants' 5/23/84 Motion for Summary Disposition, Table 3, Attachment to Iotti/Finneran Affidavit, on U-Bolts Acting As Two-Way Constraints.) From Applicants' own affidavit and attachments, I found the following: 8 supports were redesigned; 9 others had significant load increases over the loads used in the original design; and a minimum of one support failed -- 17 deficiencies out of a sample (in fact, according to Applicants, 70 was the total number of such supports). This is certainly a significant rate of failure -- significant enough so as not to require further sampling to prove that the design is flawed. Additionally, Applicants have since corrected their own affidavit, admitting that the number of U-bolts which must be replaced has been changed from the original 8 to 22, and the total number has been changed from 70 to 76, which indicates a failure rate of 29% of the total, and this is according to Applicants themselves. (See Applicants' changes in affidavits attached to their 1984 Motion for Summary Disposition, 11/85.)

For the fourth sample, we shift to Cygna Energy Services and their Phases 1 and 2 report. Of the 9 supports with calculations, the Cygna review found no problems and that everything was going according to plan. In my review of the same 9 calculations supplied by Cygna, I found major errors in engineering calculations in 6 of the packages and, in fact, in one case the support failed (as it turned out later, this was a generic problem, as there were several others of this type of failure elsewhere, although Applicants never stated anything on this point until after we brought out the fact that this configuration failed). Now here we have 67% of the 9 supports containing engineering flaws, and one of the 9 is a failure. This is definitely a significant sample, clearly demonstrating a significant reduction in the anticipated reliability of a nuclear power plant system. (See CASE's 10/6/84 First Motion for Summary Disposition, page 22.)

The fifth sample is also of Cygna's origin, the Phase 3 study done by Cygna. (See 10/6/84 CASE's First Motion for Summary Disposition, affidavit pages 49, 51, 72, 73, and 78.) Of the area examined by Cygna, their sample contained 22 supports for the main steam system. Within these, I found the following: of the 22 main steam supports, 18 had gross errors in engineering and one support required major modification due to a design failure (this information came from Cygna's raw data), but Cygna did not elaborate on the meaning of this data nor the potential consequences thereof during the life of the plant. Here again, we have a significant percentage of design deficiencies which caused no alarm for Cygna, Applicants, or the NRC Staff.

In view of the above, it seems incredible to assume that Applicants can show by any method of statistical sampling that the various systems of supports at CPSES are acceptable, unless of course they intend to perform their analysis in the same way that the NRC used in the SIT Report to prove that CPSES was ready for a license in February 1983. Beyond all of this, the use of statistical sampling does not comply with the intent of 10 CFR Part 50, Appendix B, Criterion XVI (as will be discussed in more detail later herein under CONCLUSIONS).

INTERPRETATION OF SAFETY SIGNIFICANCE

Applicants are pressing forward in at least one area: they have moved up from oracle of qualitative engineering to oracle of safety-significance.

For years it has been Applicants' firm and unswerving position that all of the supports at CPSES were properly designed and constructed. Within the recent past, however, Applicants' house of cards has started to crumble. The new party line is that, while the support does not comply with commitments which were in place at the time of the original design, it is of no consequence, since the support in question has no safety-significance. This line has been used for individual supports, dozens of supports, hundreds of supports, and now thousands of supports (see Applicants' April 18, 1986, SEC Form 8-K filing, copy of which it is our understanding has already been provided to the Board and parties by Applicants).

By altering the plane of argument from the technical to the semantic, Applicants hope to avoid responsibility for their past actions. This results when a generic semantic cloud is introduced (for example, "no safety-significance"). When this argument is offered, CASE is faced with an Orwellian task -- to do a fault tree analysis or SCA (sneak circuit analysis) to prove that singly or collectively the problems have a safety-significant impact on the plant. By their claims of no safety-significance, Applicants have moved the concept of hyperbolic imperatives one step beyond. As for myself, I find it difficult to offer logical arguments in this world of illusions created by Applicants to attempt to avoid technical responsibility.

And beyond this, I don't believe CASE must bear the burden of proof on the "safety-significant" issue on the issue of fault tree analysis. It is Applicants' argument -- let them prove that Congress intended that nuclear power plants with thousands of discrepancies (by Applicants' own admission) do not represent safety-significant issues.

The fact that the burden of proof shouldn't be on CASE is borne out by the NRC Staff. When asked about the significance of unstable supports during the hearings, Judge Bloch asked NRC Staff Witness Mr. Taylor if the effect of one support failure should be considered, to which Mr. Taylor relied "You are asking for a failure mode analysis for every run." (See Tr. 6999.) When engineering does not exceed the code limits, the safety question is answerable based on historical and existing analytical data; however, when the codes are not adhered to, we have established a new baseline with no handle on future events related to the deviations. Relative to the above, I have not noticed that the NRC Staff has volunteered to take a stand on the "safety-significance" issue and has thus far accepted Applicants' visions of safety significance.

Once one deviates from the accepted standards for engineering and design, the reliability of the facility can only be adversely affected. The fact that, for a given point in time, it can be shown that total failure will not result from overload is without relevance. I have said myself that any idiot within the industry knows that you can exceed code allowables by no less than a factor of two during a static test without experiencing a failure; this is due to the safety factor utilized for design. Therefore, by offering testing or analysis to show that a portion of the safety factor remains and that such showing would relieve the designer of the responsibility for an overload or exceeding allowables on the grounds that a 20% deviation from the code requirement would not constitute a flaw resulting in collapse is the height of absurdity, since the fact is that the code requirements have been violated and quality has been compromised over the life of the plant, thereby rendering the plant indeterminate. <u>It is no longer possible to accurately state what the probable survivability of this plant is over time. The safety margins have been undercut and you can no longer say that you can rely on that factor of safety. The real safety significance for this plant is Applicants' inability to comply with standard codes and practices</u>.

Once the Applicants took the position that it is more expeditious to remove, redesign, reinstall, reinspect supports or to redesign and modify supports than it is to qualify the as-built conditions, Applicants conceded that the support systems are not engineered but in fact are abstractions, for if the supports in the system were engineered to create the arrangements and configurations of the components, the proof of adequacy would precede the design and construction and not be required to be tailored to an ambiguous as-built system generated by guesswork. In short, the Applicants violated the fundamental rule of system reliability: "KISS" it (<u>i.e.</u>, "keep it simple, stupid"). The result is that, not only have Applicants found it impossible to qualify their abstract supports for the Licensing Board, they now can't even justify the supports to themselves. (See Applicants' Management Plan, June 28, 1985, page 67; also see corrections to Iotti/Finneran affidavit relative to their motions for summary disposition, and Applicants' April 18, 1986, SEC Form 8-K filing.)

Safety significance cannot be prophesied by great oracles nor negated by decree, particularly when the decree is issued by the perpetrator of the discrepancy requiring explanation. The constant claims of "no problem" by Applicants are in themselves safety significant. The wild unsubstantiated claims of no safety significance indicate that Applicants are not qualified to participate in any unbiased sampling technique -- because they are as convinced now that there is no safety significance to the problems as they were originally convinced that there were no problems in the first instance.

With upwards of 1/3 of the supports in Unit 1 requiring modification and others pushing the margins of safety to the point where confirmation is required on a pending change in a code, Applicants would have us believe that they and they alone are in the unique position of determining the long-term safety impact merely by prophesying that there is no safety significance. It makes one wonder why such vast sums of time and money are spent on "fault tree analysis" or sneak circuit analysis (SCA) when right down at Comanche Peak we have the prophets who can determine right off the wall what is acceptable and what is not, and they can do it with a straight face. Among other factors, it was this attempt (by the engineering industry in general) at projecting performance beyond their capacity that led the American Society of Civil Engineers (ASCE) to redefine responsibility; the ASCE found that the engineering improved between 1924 and the period of the 1960's, whereas in the period of the 1960's engineering practices have been deteriorating (<u>see</u> Attachment A hereto, page 3, 1.2, second paragraph, of ASCE "Final Report and Recommendations on Assignment of Authority & Responsibility for Design of Steel Structures," October 20, 1985).

In reference to the preceding, it has been the practice over the years for engineering corporations to dismiss certain areas of design as not important to the structural integrity of the facility. And the American Society of Civil Engineers has come down on this cavalier approach to engineering (<u>see</u> Attachment A hereto.) This has only occurred because of a rash of terrible failures to structures which were believed safe: for example, the Hartford sports center, the Kemper auditorium, and the walkway at Kansas City which killed 113.

As far as the nuclear industry is concerned, a few of the major problems with predicting accidents can be noted in the following "insignificant" incidents which resulted in major consequences. The first occurred at the Browns Ferry Plant in Alabama, where the facility came to a near-disaster due to a fire which was started by a worker's candle while performing an inspection; he inadvertently set fire to the insulation, which in turn resulted in damage to electrical cables vital to the plant protection system. A safe shutdown of the plant resulted from jury-rigging of the electrical system around the damaged cables and further damage to the plant was thereby averted. The insulating material which caused the fire to spread was not considered safety-significant prior to the accident.

The second incident was the Fermi 1 unit located at Monroe, Michigan. The accident which destroyed this plant was close to a catastrophe prior to control being restored. This accident resulted from the blockage of the coolant by a zirconium deflector which not only wasn't considered to be safety-significant, it wasn't even required.

Third, the ALPR-1 reactor in Idaho suffered a disasterous chemical explosion due to a safety device. A control rod became stuck, and when dislodged by a worker, it withdrew in excess of safe limits on the rod movement. The results were disaster.

Fourth, the support system for the steam generator at Shippingport failed at loads well below what were assumed to be safe limits, nearly resulting in a disaster for this plant. The only factor which averted a major catastrophe was the fact that the unit was just being filled with water and was not operational at the time.

Finally, there was Three Mile Island (TMI). It is ironic that, here again, we have a situation involving minor problems which collectively spelled disaster. But first, the disaster at TMI also had a bright side in that it shocked America out of complacency in regards to what may cause accidents and, in fact, introduced us to an accident which was not possible, as was pointed out during the hearings by John Kemeny before his committee formulating a report for the President. Fortunately, this benefit was bestowed at a relatively insignificant cost, mainly a monetary loss. Such lessons most often are acquired by a massive loss of life.

The factors which contributed to the TMI accident were individually of minor significance, and in fact, each malfunction had been noted as occurring prior to the accident, which was caused by their collective interaction. The contributors were: (1) A pilot-operated relief valve failed in the closed position; the indicator lights on the operator's panel were designed to announce the last command issued (not the actual valve position), the operator was unaware of the actual valve position. This simple sequence of events deprived the reactor core of coolant for over two hours. (2) The core temperature thermal sensors were capable of detecting temperatures of the fuel to several thousand degrees; however, since this was an accident that couldn't occur, the readout for the operator was limited to only 700 degrees. Therefore, the initial problem went undetected. (3) The condensate water by-pass system, which could have supplied cooling water to the reactor, was operable only on a manual basis and had design flaws that made operation during this accident next to impossible. (4) The operator overrode the computer system which activated the Emergency Core Cooling System (ECCS) and thereby ensured the accident's progression. (5) Later in the accident, the computer output fell several hours behind the events.

The results of these sequences of events outlined above led to the "Report of The President's Commission on the Accident at Three Mile Island," October 1979 (the Kemeny Report). Some of the contributions to this report and some of the findings are worth noting. One item is in reference to the mission of the NRC and others and changes required. It probably addresses the current absurdities being perpetrated at CPSES best. The conclusion to the report contains the following sage advice (page 7, OVERVIEW, OVERALL CONCLUSION):

> "To prevent nuclear accidents as serious as Three Mile Island, fundamental changes will be necessary in the organization, procedures, and practices -- and above all -- in the attitudes of the Nuclear Regulatory Commission and, to the extent that the institutions we investigated are typical, of the nuclear industry." (Underscoring in the original.)

Similar conclusions were drawn in the Rogovin Report ("Three Mile Island, A Report to the Commissioners and to the Public," Nuclear Regulatory Commission Special Inquiry Group, January 1980).

Apparently this message has been misplaced or displaced in the archives of Applicants' collective mind. I use the term "mind" advisedly, for it is difficult to imagine that anyone actually believes that the intent of Congress was to create plants intentionally that were designed and constructed to the 95/5 criterion.

CONCLUSIONS

The concept of statistical probability as a tool to determine the safety status of a plant plagued with problems is outside the scope of the art. Some of the obvious reasons for this in the case of CPSES are as follows:

1. Attributes must be known in advance, and Applicants have proven by the manner in which they have dealt with the large-bore pipe support systems that they do not know what potential problems may occur, and even when told by others, they are prone to dismiss them as being of no safety-significance.

   Further, Applicants are admittedly utilizing depleted attribute lists, which still further negates any possibility of their statistical sampling achieving the purpose for which they seek to use it.

2. In the case of CPSES, it cannot be argued that the errors leading to the contests over the last four years have been isolated. On the contrary, CASE first outlined a massive list of discrepancies in the pipe support area. CASE's investigation of Cygna's Phases 1 and 2 Report uncovered numerous discrepancies (and led to Cygna's further more intensive review) of the cable tray design and construction. The NRC's Technical Review Team (TRT), in its review of hundreds of allegations by whistleblowers and CASE witnesses, uncovered numerous faults with the construction in

general -- as well as confirming the allegation (previously dismissed by NRC Region IV as being without basis) that there were problems with the design of the Control Room itself. The NRC's Construction Appraisal Team (CAT) also noted a number of discrepancies before them. And the Atomic Safety and Licensing Board itself discussed many specific problems in its 12/28/83 Memorandum and Order (Quality Assurance for Design); etc., etc.

3. The CPSES bias is a legend in its own time. First, Applicants and NRC Staff's claim has been that there are positively no allegations that have merit, followed by the claim that none of the errors are safety-significant. Beyond this, if Applicants' position is that there are no real problems, what motivates them to alter this position and perform what they claim will be statistical sampling which is not biased in favor of the Applicants?

4. The initiation of a statistical sampling program will not correct problems which are located in positions which are not revealed by the program.

5. Institution of statistical sampling is contrary to the purpose of engineering, which is to develop structures which comply with codes and standards 100% -- not to show that the plant has only a specific level of problems within an odds frame of 19 out of 20 chances.

6. To solve problems, or in fact to determine if problems exist or are significant, one must be able to define the problem and its causes (we agree with the Board on this point; see Board's 4/14/86 Memorandum and Order (Motion to Compel Production of Checklists)). Since Applicants do not appreciate this correlation, we do not

believe that Applicants could execute a proper statistical sampling exercise to qualify any system at CPSES.

7. The directors and officers of the utility corporation serve at the pleasure of the stockholders (not the public). The upper management serves at the pleasure of the board and its officers. And lower and middle management serve at the pleasure of their upper management. The lower and middle management who are involved in the day-to-day execution of such programs as statistical sampling are effectively the same lower and middle management which directed the program which resulted in the vast array of problems outlined above. Now this same group is supposed to institute a program which will show that various systems are properly designed and constructed. This represents a classic case of conflict of interest.

8. 10 CFR Part 50, Appendix B, Criterion XVI, Corrective Action, states:

> "Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken shall be documented and reported to appropriate levels of management." (Emphasis added.)

The words are clear in Criterion XVI: "conditions adverse to quality." There is no requirement that such conditions must first satisfy a determination of safety significance, since all elements of components classified A, B, C, and MC in a nuclear power plant carry safety-significance. On this criterion, the first sentence relates to conditions less than significant conditions, which are covered in the second sentence and thereafter. Adverse conditions which are only predicted, but randomly located, cannot be corrected. Therefore, the premise of statistical sampling is counter to the requirements of Criterion XVI.

9. An important feature lacking for producing a significant statistical sample by Applicants is attitude. For that matter, Applicants' attitude is that the principal factor for consideration is "safety-significance," and this, only by Applicants' personal interpretation. Further, they are convinced that a plant with zero defects is not achievable. In fact, Applicants state that Appendix B was instituted with the understanding that errors will exist but will lack significance due to the "defense in depth" philosophy. (See Applicants' 1/31/86 Memorandum in Response to Board's Memorandum (Statistical Inferences from CPRT Sampling), page 15, top of page and Footnote 4.)

The fact that producing error-proof nuclear plants is next to impossible is not arguable. What is arguable is the cavalier attitude that we can accept a 5% flawed system based on a 95% level of confidence (and CASE does not believe that Applicants can even hope to achieve the 95/5 confidence level). The fact that errors elude diligence does not mean that once error is suspected it can be overlooked on the grounds that one knew it would happen anyway. Additionally, the term "defense in depth" refers to the complex redundance and overlapping safety systems in place to mitigate the potential consequences of an accident, that may result from unknown or unaccounted for conditions leading to a rare event or errors which have eluded or evaded the best efforts of engineers -- and not to allow for suspected flaws to be dismissed on a 95/5 basis. All references to "reasonable assurance" carry the implied belief that Applicants must have exercised every effort to ensure that the nuclear power plant has been accurately designed, constructed, and inspected to the limits of human ability to insure the public safety.

10 CFR represents the federal position for implementing the Atomic Energy Act, as amended. (See more detailed discussion in CASE's 2/3/86 Response to Board Memorandum (Statistical Inferences from CPRT Sampling), pages 2 through 8.) In no sentence in any NRC implementing regulations, and specifically in 10 CFR Part 50, Appendix B, is the thought conveyed that error is acceptable. Although it may be impossible to totally avoid error in design and construction, certainly it is not proper for an applicant to use this as an excuse for dismissing errors and defects as not being safety-significant. Further, Applicants' position is inconsistent within itself, since their statement in Footnote 4, page 15, of their 1/31/86 pleading (that there will be defects even with a QA/QC Program that is fully compliant with Appendix B) underscores the need that at a minimum the requirements of Appendix B must be followed (rather than the opposite conclusion which Applicants would have the Board adopt).

For the above reasons and those previously articulated, we believe firmly that the art of statistical sampling is not applicable for the purposes intended at CPSES.

I have read the foregoing affidavit, which was prepared under my personal direction, and it is true and correct to the best of my knowledge and belief.

(Signed) Jack J Doyle

Date: APRIL 26 1986

STATE OF MASSACHUSETTS

COUNTY OF WORCESTER

On this, the 26th day of April, 1986 personally appeared JACK J. DOYLE, known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that he executed the same for the purposes therein expressed.

Subscribed and sworn before me on the 26th day of April, 1986.

Robert F. [illegible]

Notary Public in and for the State of MASSACHUSETTS

My Commission Expires: 10/26/90

ATTACHMENT A

AMERICAN SOCIETY OF CIVIL ENGINEERS

FINAL REPORT AND RECOMMENDATIONS ON ASSIGNMENT OF AUTHORITY & RESPONSIBILITY FOR DESIGN OF STEEL STRUCTURES

October 20, 1985

1.0 INTRODUCTION

1.1 Purpose

The American Society of Civil Engineers believes that to protect the safety of the public, a continuing responsibility of a qualified licensed professional engineer, or firm of engineers, can and must be required for all steel structures. That responsibility should include design, shop drawing review and the observation of construction of all structural systems included in a project.

1.2 Background

The system for building steel structures in the United States is complex, involving many parties and various contractual arrangements. The Owner, Engineer, Architect, General Contractor, Fabricator, Detailer, Erector and Inspector all perform specific tasks in the design/construction process. Defining by contract the scope of work and responsibilities of the various parties is paramount to achieving quality and integrity in steel structures.

In the early part of this century there were many inconsistent practices for steel construction. In 1924 the American Institute of Steel Construction (AISC) initiated its Code of Standard Practice which provided some uniformity. However by the late 1960's, changes in technology and society as a whole began to have an adverse effect on these practices. Court decisions relating to liability and restraint of trade, fast-track construction, a highly competitive market, high inflation and interest rates, changes in engineering college curricula, escalating labor costs, discontinuance of standard connections by AISC, and the development of computer techniques allowing the creation of more sophisticated structural systems all had their effect. The resulting new and often confusing trends in design and construction practices are affecting design responsibilities and led the Professional Practice Division of ASCE to appoint the Task Committee on Design Responsibility and initiate this study.

1.3 Charge to the Task Committee on Design Responsibility

The Charge to the Task Committee is stated in the minutes of the meeting of the Professional Practice Division Executive Committee (PRODEX) held in Boston, MA, on June 16-17, 1983, and reads as follows:

> "To investigate the perceived problem of the transfer of certain aspects of responsibility for design of steel structures to the structural steel fabricator and to make recommendations for guidelines to professional practice in this regard."

2.0 DEFINITION OF TERMS

The meanings of some terms used in engineering practice and the structural steel industry differ somewhat from ordinary/dictionary definitions. Therefore, the following definitions are provided in order that certain critical terms used in this report will be uniformly understood.

1. Design

(As a transitive verb) The process of utilizing the principles of structural mechanics and materials science to determine the size, shape, composition, and arrangement of structural components to create a structure suitable for its intended purpose. Design is performed by or under direct supervision of a qualified licensed professional engineer.

(As a noun) The product of the design process, as expressed by drawings, specifications, notes or other descriptive material.

2. Design Drawings

Graphic diagrams and details that describe the proposed structure with sufficient information so that shop drawings can be prepared.

3. Specifications

Written technical requirements which supplement the design drawings and define materials, workmanship, quality control procedures, and identify the governing codes/standards.

4. Contract Documents

The design drawings, specifications, general and supplementary provisions, addenda, and any change orders that define the complete scope of the project and the terms and conditions for performing the contract.

5. Shop Drawings

Graphic diagrams of structural members and components that show construction information and serve as the basis for fabrication of the structural steel.

6. Erection Plans

Assembly diagrams that describe the sequence and method of site assembly of the fabricated structural components.

7. Owner

The public body or authority, corporation, association, firm or person for whom the structure is designed and built.

8. Engineer of Record (EOR)

The licensed professional engineer who develops the design criteria and framing concept for the structure, performs the analysis, and is responsible for the preparation of the design drawings and specifications. The EOR is commonly identified by the professional engineer's seal on the design drawings. If the ERO is a consultant, he/she may be either the prime professional, or a professional associate working for an architect, planner, or construction manager.

9. General Contractor

The person, firm or corporation with whom the Owner has entered into an agreement to construct the project.

10. Fabricator

The company that fabricates structural steel components in accordance with the requirements of the shop drawings.

11. Detailer

The individual or organization that prepares the shop drawings and erection plans for the project. The Detailer may be the drafting department of the Fabricator or an independent firm to whom the Fabricator sub-contracts the work.

12. Erector

The company that erects the fabricated structural steel components at the site.

13. Inspector

The organization, firm or testing laboratory retained by the owner to verify that the steel construction is in compliance with the contract documents.

14. Detail

(As a transitive verb) The process of utilizing the principles of geometry and the art of graphics to develop the exact dimensioning of structural components so that they can be manufactured by the Fabricator in accordance with the design drawings. Detailing is often performed by non-engineers.

(As a noun) The product of the detailing process, usually shown on contracts and shop drawings, such as the graphic depiction of a connection.

15. Connections

The structural components that transfer forces from one member to another within a structure. These include strengthening and reinforcing elements for the structural members.

16. Responsibility

Accountability for properly executing the services and/or for furnishing and erecting the materials which the party is authorized, by contract, to perform. As used in this report, responsibility must co-exist with authority.

17. Authority

The power, conferred or implied by contract, to exercise effective direction and control over an activity for which a party has responsibility. As used in this report, authority must co-exist with responsibility.

18. Shop Drawing Approval

Review and approval of (or other appropriate action in respect of) Shop Drawings, samples and other data which the General Contractor is required to submit, but only for conformance with the design requirements of the structure and compliance with the information given in the contract documents. Such reviews and approvals or other action shall not extend to means, methods, techniques, sequences or procedures of construction, or to safety precautions and programs incident thereto.

3.0 RECOMMENDED GUIDELINES

The definition by contract of work assignments and responsibilities are prime considerations for providing integrity in fabricated steel structures. The Owner, Engineer, Architect, General Contractor, Fabricator, Detailer, Erector, and Inspector are all deeply involved with the integrity of the proposed structure.

The contractual arrangement for design that offers the best control of structural integrity is one under which the EOR has responsibility and authority for the entire structural design, including the connections. The guidelines proposed herein should serve to eliminate confusion and misunderstanding in the performance of structural steel contracts.

3.1 Contractual Arrangements

(1) The EOR should have responsibility and authority for all aspects of the structural design. The EOR's contract should specify that he/she either (a) design the connections, or (b) review and approve the connections selected and detailed by the Fabricator.

(2) The Fabricator should have responsibility and authority for properly implementing the design drawings, properly furnishing materials and workmanship, maintaining the specified fabrication and erection tolerances, and for fit and erectibility of the structure. The Fabricator should prepare shop drawings in accordance with the design information supplied in the contract documents and subsequent instructions from the EOR.

(3) The contract documents should specify that the Fabricator either (a) detail the connections as designed by the EOR, or (b) select and detail the connections for review and approval by the EOR.

(4) For complex steel structures, the EOR may specify in the contract documents that the Fabricator have a licensed professional engineer design the connections. In such cases, the EOR should still review and approve the connections.

(5) The EOR should have sufficient time and compensation to prepare design drawings and to review and approve shop drawings in order to produce safe structures.

(6) The design drawings should provide sufficient information for the Fabricator to produce correct shop drawings.

(7) The EOR should review and approve shop drawings prepared by the Fabricator for compliance with the strength and stiffness requirements of the design.

(8) In those cases where the Fabricator requests permission to revise certain connections to facilitate fabrication and/or erection, the EOR should review and approve the Fabricator's revisions. The Fabricator should reimburse the EOR for costs incurred in making this review.

(9) Requirements that the Fabricator be certified to perform the work should be specified by the EOR in the contract documents.

(10) Where the design involves a non-self-supporting steel frame, the contract documents should indicate which party is responsible for the design of the construction bracing and how long such bracing needs to remain in place.

(11) Where erection procedures require special design and calculations, the contract documents should specify that the Erector have a licensed professional engineer perform these services. The EOR's review of this work should be limited to its effect on the integrity of the main structure.

(12) On-site observation by the EOR as well as the services of an independent agency for shop and field inspection are also essential project elements with a cost. The Engineer and the Architect should apprise the Owner of these facts at the time of entering into the contract for professional services.

3.2 Rationale

These recommended contractual guidelines should provide the best assurance of quality and integrity of structural design through the clear assignment of responsibilities and authority among the parties involved with the project. Having the EOR involved in all aspects of the structural design process will enhance the structural integrity of the facility and promote the successful completion of the project by centralizing control of the design and decision making process, and providing for continuity.

On the other hand, contractual arrangements which fail to include clear assignment of responsibility and authority for design of structural elements and connections, or which tend to impose on one party the proper responsibilities of another party, are considered to be counterproductive and should be avoided.

4.0 OTHER RECOMMENDATIONS

4.1 Communication

(1) The contract documents should clearly define the lines of communication among the Owner, EOR, General Contractor, Fabricator, Detailer, Erector, and Inspector.

(2) One or more prebid and/or preconstruction conferences should be held, during which lines of communication and responsibilities are identified, and the contract requirements are discussed.

(3) After award of the contract, the Fabricator and Detailer should meet with the EOR to review design requirements and criteria for detailing the connections. In those cases where the Fabricator plans to submit design changes, prior approval should be secured from the EOR, keeping the General Contractor informed.

(4) The Fabricator and/or the Detailer should have a direct channel of communication with the EOR as the project goes forward and should keep the General Contractor informed.

(5) The Fabricator should request clarification in writing from the EOR on special connections or unusual structural conditions not clearly defined by the design drawings or specifications.

(6) A Fabricator and/or Erector who retains a licensed professional engineer for design of connections and/or erection procedures should authorize that engineer to communicate directly with the EOR, but the Fabricator and/or Erector should coordinate the work and keep the General Contractor informed.

4.2 Quality Assurance and Quality Control

(1) Contractual relationships between the parties involved in the project are vitally important to its quality and structural integrity and should follow the concepts outlined in this report.

(2) Clearly delineated and efficient office procedures are critical to the administration of design, control and checking of shop drawings; and for the processing of design changes; and should be vigorously pursued.

(3) The Fabricator/Erector should provide ongoing inspection and testing to determine that quality is in conformance with the contract documents. This should be augmented with inspection by the Owner's inspector and on-site observation by the EOR where appropriate.

(4) Design and construction should be in compliance with all governing building, safety and technical codes/standards to assure quality and structural integrity.

Prepared by the Task Committee on Design Responsibility

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AMERICAN SOCIETY OF CIVIL ENGINEERS POLICY STATEMENT

AUTHORITY AND RESPONSIBILITY FOR DESIGN OF STEEL STRUCTURES

Approved by the Professional Activities Committee
on July 9, 1985.
Approved by the Committee on Policy Review on September 4, 1985.
Adopted by the Board of Direction on October 20, 1985

Policy

The American Society of Civil Engineers believes that the safety of the public can best be protected by having a licensed and qualified engineer perform the design and review, approve the shop drawings, and provide appropriate on-site observation of construction of all steel structures. Clear definition by contract of work assignments, authorities and responsibilities during the design and construction process is a primary consideration for providing integrity of steel structures. The owner, engineer of record, architect, general contractor, fabricator, detailer, erector and inspector all have important roles in the design and construction process, and each must do his/her part to achieve this necessary integrity. The contract arrangement for design that offers the best control of structural integrity is one under which the engineer of record has responsibility and authority for the structural design, including the connections.

Issue

The engineering profession views with great concern failures of steel structures, and ASCE has reviewed the engineer's role in design and construction practices as related to his/her professional responsibilities to society. ASCE believes that failures have resulted, in substantial part, because of loss of continuity and communication as a project moved through the phases of design, review of shop drawings and construction. Every effort must be made to avoid failures by careful definition of authority and responsibility by all of the parties involved in a project.

Rationale

Involving the engineer of record in all aspects of the structural design process should enhance the structural integrity of the facility and promote the successful completion of the project by centralizing control of the design decision-making process, and by providing continuity. Clear definition of authority and responsibility by contract provides the best assurance for that central control and continuity. Contractual arrangements that fail to include clear assignment of responsibility and authority for the design of structural elements and connections, which divide and fragment such responsibility and authority, or which tend to impose on one party the proper responsibilities of another party, are considered to be counterproductive and should be discontinued. The suggested authorities and responsibilities are:

1. The engineer of record should have responsibility and authority for all aspects of the structural design and his/her contract should provide sufficient time and compensation for implementing this role. In addition to design of the structural members, his/her contract should specify that he/she either (a) designs the connections, or (b) reviews and approves all shop drawings, including connections selected and detailed by the fabricator. During construction, the engineer of record should make appropriate on-site observations.

2. The fabricator should have responsibility and authority for properly implementing the design drawings, properly furnishing materials and workmanship, maintaining the specified fabrication and erection tolerances, and for fit and erectability of the structure. The fabricator should prepare shop drawings in accordance with the design information supplied in the contract documents and subsequent instructions from the engineer of record. The construction contract documents should specify that the fabricator either (a) details connections as designed by the engineer of record, or (b) selects and details connections for review and approval by the engineer of record.