AFFIDAVIT

I, Susan L. Hiatt, OCRE Representative, duly sworn depose and say that:

A. the statements below are true to the best of my knowledge and belief; and

B. Ohio Citizens for Responsible Energy cannot present at this time facts essential to justify its opposition to the Staff's Motion for Summary Disposition of Issue #13 for the following reasons:

1. OCRE would like to present a direct case on this issue, and is actively pursuing the acquisition of expert consultants and witnesses in evaluating this complex technical issue;

2. OCRE has only recently received documents requested from Applicants and the NRC, specifically:

   (a) documents requested on April 5, 1983 from the NRC's Public Document Room were received on or about May 20, 1983;

   (b) documents requested from Applicants on April 21, 1983 were received on or about May 26, 1983;

   (c) both classes of documents above pertain directly to Issue #13;

3. OCRE has had insufficient time to thoroughly review and evaluate these extensive documents because of the recent hearing on quality assurance and because of the time necessary to prepare the proposed findings related thereto;

4. OCRE believes that further discovery will be necessary on this issue, both as follow-up on said documents and to properly prepare its case, especially in light of the Board's statements in the recent hearing that (much to OCRE's astonishment) what was considered cross-examination by intervenors was in fact discovery;
5. As stated in the preceding brief, OCRE believes that in the interest of developing a full and complete record, the litigation of Issue #13 should await further data, evidence, and information, including the submittal of a report by General Electric;
6. OCRE believes that any delay caused thereby will not prejudice any party and is far outweighed by the benefit of having a complete record in this proceeding;
7. OCRE further believes that both justice and Commission precedent demand that intervenors be given the time needed to properly prepare their case on Issue #13; specifically, the Appeal Board in Southern California Edison Co. (San Onofre Nuclear Generating Station), ALAB-212, 7 AEC 986, 992-93 (1974) held that in view of the disparity of resources between Staff and Applicant on one hand, and intervenors, on the other, it is proper to allow intervenors additional time for case preparation. This is not controverted by the Commission's policy statement, CLI-81-8, 13 NRC 452 (1981), since the Commission continually iterates therein that its proceedings are to be conducted in a fair and thorough manner.

Susan L. Hiatt
OCRE Representative

Sworn to and subscribed before me this 23rd day of June, 1983.

Notary Public
MARLEY FORD EIGER, Attorney At Law
Notary Public - State of Ohio
My commission has no expiration date.
Section 147.03 R. C.

ATTACHMENT 1

LARGE STEAM TURBINE-GENERATOR DIVISION

NUCLEAR WHEEL SEMINAR

MAY 5 - 6, 1982

ALBANY, NEW YORK

GENERAL ELECTRIC

Nearly all of the turbine generators produced to date by the Large Steam Turbine-Generator Department of General Electric for use with nuclear reactor cycles, are tandem compound machines with rotational speeds of 1500 or 1800 rpm. The cross-section of a typical GE nuclear turbine generator is shown in Figure 1. The unit shown is a six-flow design, having three low pressure sections. For some applications a four-flow design has been applied, having two low pressure sections. The high pressure turbine rotor is machined from an integral forging and a composite construction is used in the low pressure turbine rotors.

Figure 2 is a cross-section of a typical nuclear turbine low pressure section. The last stage buckets may have active lengths of either 38" or 43" at 1800 rpm. Note that in the General Electric impulse design each wheel carries only a single stage. No multiple stage wheels are employed. The wheels are shrunk-on to a shaft and are keyed to the shaft using the configuration shown in Figure 3. This configuration has been very carefully optimized to limit stress levels. Our design employs an axial rectangular keyway to prevent wheel rotation during severe transient conditions when shrink may be temporarily lost. In addition, we employ a circumferential locking ring to inhibit axial movement during these kinds of transients. The keyways and locking ring grooves have been carefully designed to minimize the resulting stress concentration factors and the designs which we employ in nuclear machines are typical of those which have been used successfully for a number of years in fossil applications.

The design of a low pressure turbine is complex and requires the resolution of a number of design factors. It must, of course, be designed for high reliability; however, proper attention must also be given to steam path efficiency. There are a number of design considerations which must be reconciled before the wheel configuration, the material properties employed, and resulting stress levels can be established. We have endeavored to produce a design which has reasonably low stresses in the buckets, wheels and shafts, which therefore does not require materials of unnecessarily high tensile strength to achieve adequate design margins.

Fossil low pressure sections having designs similar to those currently used in nuclear turbines have accumulated a large amount of excellent service experience. There are 235 fossil units in service with shrunk-on wheels, some of which have been in service more than 30 years. Designs having comparable stress levels, materials and configurations were introduced into double flow fossil low pressure sections in mid 1960's.

In spite of the excellent service experience of our fossil shrunk-on construction, we recognized that it would be extremely desirable to be able to inspect the regions of shrunk-on wheels in place (e.g. - without having to remove them from the shaft). Therefore, we initiated a program in the early 1970's to develop wheel boresonic test equipment and procedures which would permit the inspection of shrunk-on wheels in situ. This development program was completed in 1977, after thorough laboratory evaluations and successful field trials. After we were convinced that we had viable in-service wheel inspection equipment and procedures, we issued Technical Information Letter #857 in early 1978, recommending that all nuclear wheels be inspected at approximate six year intervals. Initially, we had very few requests for in-service nuclear wheel inspections. However, problems with the shrunk-on wheels of another vendor's equipment resulted in a fairly large number of inspections, starting in 1980. The results of inspections conducted through the end of 1980 are shown on Figure 4. The sonic indications which had been detected during these inspections were thought not to be stress corrosion cracks, for reasons to be discussed in the following material. At that time, we judged that the indications were due to a "water cutting" mechanism involving a combination of corrosion and erosion. Tests conducted late in 1981, however, showed quite conclusively that some of the larger indications were indeed stress corrosion cracks.

A summary of inspections through 1981 is shown on Figure 5. The depth of these more recently observed indications, together with fiber optic photographs taken, and the inspection of a wheel removed from service, have resulted in our current assessment:

- Stress Corrosion Cracks Exist
- They are Concentrated in Regions of 5th LP Stage

- Growth Rates are Faster than We had Previously Assumed
- The Exact Mechanism is Not Understood

The subsequent discussion outlines in greater detail the total inspection results, the interpretation applied to them, and the programs that we have in place to resolve this problem.

ATTACHMENT 2

LARGE STEAM TURBINE-GENERATOR DIVISION

NUCLEAR WHEEL SEMINAR II

AUGUST 23 - 24, 1982

CHICAGO, ILLINOIS

GENERAL ELECTRIC

ROTOR INSPECTION STATUS 7/82

Greater Than 6 Years Service

	Total Number Rotors in Service	Total Number Inspected
BWR	58	46 (79%)
PWR	29	18 (62%)
Total	87	64 (74%)

Less Than 6 Years Service

	Total Number Rotors	Total Number Inspected
BWR	13	6 (46%)
PWR	4	2 (50%)
Total	17	8 (47%)

Figure 1

NUCLEAR WHEEL INSPECTION RESULTS (7/82)

NO. INSPECTED	Total	KEYWAY INDICATIONS Total
Wheels	1111	131 (12%)
Rotors	72	50 (69%)
Units	34	25 (74%)

Measured Radial Ultrasonic Indication Depths

BWR Plants = Shallow to 1.8"
PWR Plants = Shallow to 0.12"

Figure 2

ATTACHMENT 3

May 23, 1983

DIST:
Document Control (50-440/441)
NRC PDR
PRC System
LB#1 Rdg.
JYoungblood
MRushbrook
JStefano
TNovak

Docket Nos.: 50-440
and 50-441

MEMORANDUM FOR: J. J. Ray, Chairman
Advisory Committee on Reactor Safeguards

FROM: Thomas M. Novak, Assistant Director
for Licensing
Division of Licensing

SUBJECT: TECHNICAL REPORT ON THE PERRY NUCLEAR POWER PLANT TURBINE MISSILE ISSUE

Introduction

The subject issue concerns protecting safety-related structures, systems and components from potential turbine missiles by requiring a maintenance program that will assure high turbine generator system reliability. The placement and orientation of the Perry turbine generators in relation to other plant buildings are unfavorable, placing safety-related equipment in those buildings within the low-trajectory strike zone of potential turbine missiles. In its review of the applicant's (the Cleveland Electric Illuminating Company or CEI) Final Safety Analysis Report for Perry, the staff found that the following plant structures are within the potential turbine missile strike zone: the control rooms for Units 1 and 2; the cable spreading room; the HVAC equipment room; the intermediate fuel handling building; the electrical penetrations area; and the Unit 1 and 2 reactor buildings. The estimated damage impact on safety-related equipment within these areas from turbine missiles includes the potential for rendering the control rooms inoperable, the collapse of building structures onto safety-related electrical cables and equipment, and the possible penetration of containment. Since the applicant could not demonstrate that its plant design and turbine maintenance program were such as to provide the required protection against turbine missiles, the staff considered this to be an outstanding (unresolved) issue in Section 3.5.1.3 of the Perry SER (NUREG-0887).

This issue was the subject of discussion during the 267th meeting of the ACRS Committee on July 8-10, 1982, in considering the CEI application for an operating license for Perry Unit 1. (Consideration of a license for Unit 2 was deferred by the Committee to a later time closer to the estimated Unit 2 fuel load date). The Committee expressed dissatisfaction with progress being made at that time by the staff on the resolution of this issue during the meeting, and in the ACRS letter (P. S. Shewmon) to the Chairman, NRC, dated July 13, 1982, the Committee requested that a technical report be provided which discusses and evaluates the problems involved with the turbine missile

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issue. This report specifically responds to that request in regard to the Perry plant, and presents the staffs' findings on this issue, which was documented in Supplement No. 3 to the Perry SER.

Summary of Staff Evaluation Findings

Since issuance of the SER and Supplements 1 and 2 thereto, the staff has completed its review of the turbine missile issue, to the extent possible at this time, and as indicated above, the staff's evaluation findings have been documented in Supplement No. 3 to the SER.

On the basis of its continuing review, the staff has concluded that the probability of unacceptable damage to safety-related structures, systems and components due to turbine missiles is acceptably low (i.e. less than 10^{-7} per year) provided that the total turbine missile generation probability is such that conformance with the criteria presented in Supplement No. 3 to the SER is maintained throughout the life of the plant by an acceptable inspection and test program. In reaching this conclusion, the staff took into consideration the unfavorable orientation of the Perry turbine generators.

The turbine generators at Perry were supplied by General Electric (GE), who is in the process of completing development of methods and techniques required to calculate turbine missile generation probabilities. These methods and techniques are to relate turbine maintenance (procedures as well as inspection and testing intervals) to the probability of generating missiles. GE intends to submit reports describing this work to the staff for review and acceptance by June 1983. Following acceptance by the staff, GE will provide the applicant (CEI) with a report describing the results of analyses specific to the Perry turbines, based on the NRC accepted methods and techniques. The applicant is expected to use the GE report to formulate a turbine maintenance program which it will then submit to the staff for approval.

In regard to turbine generators in general, the staff is not aware of any turbine rotor rupture due to crack propagation (i.e., brittle fracture) that occurred within three years of plant startup. Furthermore, within three years of startup, no cracks have been observed in a GE turbine wheel with depths greater than one-half the critical crack depth calculated for that wheel. For these reasons, the staff is allowing CEI up to three years from initiation of power output to propose a revised turbine system maintenance program, which establishes inspection and test procedures and schedules consistent within NRC accepted methods, and obtain NRC approval of its program. Accordingly, the staff's approval of the CEI turbine system maintenance program will be made a condition in the operating license issued for Unit 1, and until the program is approved, CEI will be required to volumetrically inspect all low pressure turbines and to conduct steam valve maintenance (following initiation of power output) in accordance with the interim procedure for demonstrating compliance with NRC regulations delineated in Section 3.5.1.3.1.5 of Supplement

No. 3 to the SER, at the second refueling outage and every other (alternative) refueling outage thereafter. (See Attachment A for the staff's evaluation inputs incorporated in Supplement No. 3). In a letter dated March 31, 1983, CEI committed to provide a turbine system maintenance program and perform the turbine inspection and maintenance required by the staff pending NRC approval of the Perry turbine system maintenance program.

The rationale and review methodology used by the staff in arriving at this finding is summarized in the section which follows.

Summary of Staff Rationale and Review Methodology

During the past several years the results of turbine inspections at operating nuclear facilities show that cracking to various degrees has occurred at the inner radius of turbine disks, particularly those of Westinghouse design. Within this time period, there has actually been a Westinghouse turbine disk failure at one facility owned by the Yankee Atomic Electric Company. Furthermore, recent inspections of General Electric turbines have also resulted in the identification of disk keyway cracks. The Division of Engineering staff has been following this development closely and has (as discussed in Attachments A and B) set turbine missile generation probability guidelines for establishing turbine disk inspection frequencies, and guidance for turbine control and overspeed protection systems maintenance and testing to preclude missile producing failures. Both Westinghouse and GE are in the process of establishing models and methods for calculating turbine missile generation probabilities for their respective turbine systems.

Although it can be argued that large steam turbines and their auxiliaries are not safety systems as defined by NRC regulations, failures that occur in these turbines can produce large, high energy missiles. If a missile were to strike any of the safety-related structures, systems, or components, it could render them unavailable to perform their safety function. It is the staff's view that sufficiently frequent turbine testing and inspection are the most effective means of assuring the protection of safety-related structures, systems, and components. Therefore, it is prudent for turbine manufacturers to perform, and for the NRC to review, analyses of turbine reliability, which include known and likely mechanisms, expressed as a function of time; i.e., inservice inspection or test intervals.

General Design Criteria 4, "Environmental and Missile Design Bases," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires, in part, that structures, systems, and components important to safety be appropriately protected against the effects of missiles that might result from equipment failures. Regulatory Guide (RG) 1.115 "Protection Against Low-Trajectory Turbine Missiles," and Standard Review Plan (SPR) Sections 3.1.5.3, "Turbine Missiles", 10.2 "Turbine Generator," and 10.2.3 "Turbine Disk Integrity" contain present NRC guidelines for evaluating the turbine, analyzing the plant

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layout, and minimizing the risk to safety-related structures, systems, and components due to potential turbine missiles. However, the staff considers that certain aspects of this Guide and these SRP sections are no longer suitable. Therefore, the staff has altered its review procedure accordingly, to place emphasis on maintaining the turbine integrity.

In view of current experience and the safety objectives of the staff, they have emphasized the turbine missile generation probability (i.e., turbine system integrity) in its reviews of the turbine missile issue and eliminated the need for elaborate and somewhat ambiguous analyses of strike and damage probabilities given an assumed turbine failure rate. Although straightforward in principle, the latter calculations have to be based on detailed facility information and assumptions as to missile shape and size, missile energies, barrier penetration potential and ultimately to the likelihood of striking and damaging a facility safety system. Generally, there are significant differences between licensee's or applicant's submittals and the final evaluation by the staff. Nevertheless, the staff concludes, based on its experience, and on simple estimates for a variety of plant layouts, that the strike and damage probability product can be reasonably taken to fall in a characteristic narrow range which is dependent on the gross features of turbine generator orientation; (a) for favorably oriented turbine generators P_2 P_3 tend to lie in the range 10^{-4} and 10^{-3} , and (b) for unfavorably oriented turbine generators P_2 P_3 tend to lie in the range 10^{-3} and 10^{-2} (this estimate is within the range of the staff's strike damage probability estimate contained in Supplement No. 5, Section 10.2, of the SER related to Perry construction, issued in February 1977). More refined analyses or additional calculations for other facilities are unlikely to change this conclusion. Therefore, expensive and time consuming strike probability analyses on the part of applicants/licensees and/or the NRC staff are judged to be unwarranted.

With regard to Perry, the staff acknowledges that the orientation of the PNPP turbine generators are unfavorable; i.e., there are safety-related structures, systems, and components within the low trajectory turbine missile strike zones, and that the applicant has not followed NRC recommendations stated in R.G. 1.115. It is the staff's view that as a result of this design choice (with unfavorable turbine generator orientation), the applicant has taken a penalty of about an order of magnitude in the probability of unacceptable damage to safety-related systems (compared to a design with favorable turbine generator orientation). The staff does not conclude, however, that this design choice is unacceptable. Rather, as stated in Attachment A, the staff concludes that the turbine missile risk for Perry Nuclear Power Plant Units 1 and 2 is acceptable provided the NRC recommendations described therein and documented in SSER No. 3 are adopted by the applicant, which the Perry applicant has agreed to comply with in a letter dated March 31, 1983.

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In conclusion, the staff considers certain aspects of the review procedures in R.G. 1.115 and SRP Sections 3.5.1.3, 10.2 and 10.2.3 to be unsuitable for providing assurances of protecting systems important to safety from turbine missiles. The regulatory emphasis in the past has been on the evaluation of the probability that generated missiles will strike safety-related systems. The staff has proposed (a) a new SRP Section 3.5.1.3, "Turbine Generator System Reliability (Turbine Missile Prevention)" (see Attachment C), which shifts the emphasis to the evaluation of the probability of generating missiles, and (b) a new supporting R.G. 1.115 "Protection Against Turbine Missiles" (see Attachment B). The proposed SRP Section and Regulatory Guide, which are intended to replace the current SRP Sections and Regulatory Guide, will help improve the turbine generator system reliability, reduce considerably the analytical burden placed on licensees/applicants, and at the same time maintain the high level of protection of public health and safety. The procedures described in the proposed new SRP Section 3.5.1.3 and R.G. 1.115 were applied by the staff in reviewing the Perry FSAR, the results of which are discussed in Attachment A and documented in Supplement No. 3 to the Perry SER, issued in April 1983.

This report completes NRR action requested in paragraph 10 (top of page 3) of the ACRS letter to the NRC Chairman, dated July 13, 1982. The letter to the Chairman was reproduced in its entirety in Appendix G, Supplement No. 1 to the Perry SER, issued in August 1982.

Thomas M. Novak, Assistant Director
for Licensing
Division of Licensing

Attachments:
A. Memo to T. A. Novak fm W. V. Johnston dated 3/29/83
B. Proposed changes to Regulatory Guide 1.115
C. Proposed changes to SRP (NUREG-0800) Section 3.5.1.3

cc w/attachments:
H. R. Denton
D. G. Eisenhut
R. H. Vollmer
W. V. Johnston
B. D. Liaw
J. O. Schiffgens
J. M. Cutchin IV
P. S. Shewmon
A. Cappucci

OFFICE	DL:LB#1	DE:MEB	DE:AD/MQE	DE:DIR	NRR	DL:AD/L	DL:DIR
SURNAME	JVStefano/ig	BDLiaw	WVJohnston	RHVollmer	EGoodwin	TMNovak	DGEisenhut
DATE	04/29/83	05/2/83	05/ /83	05/ /83	05/ /83	05/ /83	05/ /83

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REGULATORY RESEARCH

DRAFT REGULATORY GUIDE AND VALUE/IMPACT STATEMENT

June 1983
Division 3
Task ES 114-4

Contact: T. J. Nicholson (301)427-4585

ATTACHMENT 4

GUIDELINES FOR GROUND-WATER MONITORING AT IN SITU URANIUM SOLUTION MINES

A. INTRODUCTION

An applicant for a new license or renewal of an existing license to receive, possess, and use source material in conjunction with uranium solution mining is required to provide detailed information on the proposed activity and its effect on the quality of the environment. General guidance for filing an application is provided in § 40.31, "Application for Specific Licenses," of 10 CFR Part 40, "Domestic Licensing of Source Material." Section 40.32, "General Requirements for Issuance of Specific Licenses," states that a specific license will be granted if, among other things, equipment, facilities, and procedures are adequate to protect health and minimize danger to life or property and to protect environmental values. One of the concerns in uranium solution mining is the potential for contaminating ground water. Therefore, a ground-water monitoring program and appropriate documentation of its design, installation, and implementation are needed for in situ solution mining facilities.

This regulatory guide provides guidance acceptable to the NRC staff for ground-water monitoring at in situ uranium solution mines.* It provides specific guidance in the following areas:

1. Preoperational, operational, and postoperational surface-water and ground-water monitoring locations;

*Branch Technical Position, "Groundwater Monitoring at Uranium In Situ Solution Mines," WM-8102, provides the basis for this guide. Copies are available on request from Chief, Uranium Recovery Licensing Branch, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

CERTIFICATE OF SERVICE

This is to certify that copies of the foregoing OCRE RESPONSE TO NRC STAFF'S MOTION FOR SUMMARY DISPOSITION OF ISSUE #13 were served by deposit in the U.S. Mail, first class, postage rpepaid, this 24th day of June, 1983 to those on the service list below.

Susan L. Hiatt

Susan L. Hiatt

SERVICE LIST

Peter B. Bloch, Chairman
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Comm'n
Washington, D.C. 20555

Dr. Jerry R. Kline
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Comm'n
Washington, D.C. 20555

Mr. Glenn O. Bright
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Comm'n
Washington, D.C. 20555

Docketing & Service Section
Office of the Secretary
U.S. Nuclear Regulatory Comm'n
Washington, D.C. 20555

James M. Cutchin, IV, Esq.
Office of the Executive
Legal Director
U.S. Nuclear Regulatory Comm'n

Jay Silberg, Esq.
1800 M Street, N.W.
Washington, D.C. 20036

Atomic Safety and Licensing Appeal Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Terry Lodge, Esq.
824 National Bank Bldg.
Toledo, OH 43604