UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
METROPOLITAN EDISON COMPANY, ET AL.	)	Docket No. 50-289
	)	(Steam Generator Repair)
(Three Mile Island Nuclear Station, Unit No. 1)	)	

AFFIDAVIT OF CONRAD E. McCRACKEN AND STANLEY KIRSLIS
IN SUPPORT OF SUMMARY DISPOSITION OF TMIA CONTENTION 2.a.

We, Conrad E. McCracken and Stanley Kirslis, being duly sworn do depose and state:

1. We are employed by the Nuclear Regulatory Commission in the Division of Engineering, Office of Nuclear Reactor Regulation. Conrad E. McCracken's qualifications are set forth in the affidavit submitted by him in support the Staff's motion for summary disposition of TMIA Contention 1.a., and is incorporated herewith. Stanley Kirslis is a Chemical Engineer in the Chemical Technology Section of the Chemical Engineering Branch who reviewed the Licensee's proposed cleanup procedures and the desulfurization of the reactor system. A copy of Mr. Kirslis' professional qualifications is attached. We certify that we have personal knowledge of the matters set forth herein, and that the statements made are true and correct to the best of our knowledge and belief.

2. TMIA Contention 2.a. states as follows:

> Neither Licensee nor the NRC staff has demonstrated that the corrosion which damaged the steam generator and other RCS components and systems, will not reinitiate during plant operation and rapidly progress, attacking either the steam generator or elsewhere in the primary pressure boundary, thus providing no reasonable assurance that the operation of TMI-1 with the as-repaired steam generator can be conducted without endangering the health and safety of the public, for the following reasons:
>
> a. There is no assurance that the causative agent or the source of initiation or the conditions under whch initiation originally occurred, have been properly identified, thus undermining any conclusion that the causative agent has been removed from the system, and undermining the reliability of any proposed clean-up process, procedures meant to eliminate the corrosive environment, or the reliability of the Licensee and staff stress analysis as to when corrosion could reoccur.

3. TMIA states that "no" assurance is provided that the causative agent or source of initiation has been properly identified. In its response to interrogatories, TMIA cites NUREG-1019 at pages 7-8 as support for this statement, and contends that it is there concluded, without support, that 4 to 5 ppm sodium thiosulfate caused the corrosion. Additionally, they contend that page 8 states "that the failure scenario has not been clearly established."

4. Extensive tests have been conducted which have clearly identified the causative agent as a reduced sulfur species. This is stated in numerous sections of NUREG-1019, its attachments and Topical Report 008, Rev. 3 and its references (see Topical Report 008, Rev. 3, pg. 10 ¶ f.; NUREG-1019, Section 3.1, pg. 6, ¶ d, pg. 8 Conclusion, pg. 29, last ¶, Attachment No. 2, pg. 9, Attachment No. 3, pg. 11, 2nd ¶, last sentence, Attachment No. 4, pg. 26, ¶ i, ii, iii). These tests consisted of removal and examination of sections from 29 tubes from the TMI-1 OTSG's, which showed the presence of sulfur on crack surfaces and

the absence of other corrosion-causing contaminants, analyses of liquid samples from many plant systems and laboratory tests which simulated plant conditions and verified that a reduced sulfur species can cause the type of SCC observed. Therefore, reasonable assurances have been provided that the causative agent which initiated the corrosion has been identified.

5. TMIA's contention that page 8 of NUREG-1019 states "that the failure scenario has not been clearly established" (TMIA Response to Staff Interrogatory No. 25) is a misquote and taken out of context. The full quote states:

> The specific mechanistic steps involved in the sulfur-induced stress corrosion cracking phenomenon have not been clearly established; however, the fact that thiosulfate, like tetrathionate, can cause IGSCC of sensitized stainless steels has been well recognized and investigated since the 1950's, and furthermore, experimental results obtained by the licensee and the staff consultant indicate that the TMI-1 steam generator tubing specimens cracked in borated aqueous solutions at room temperature with thiosulfate concentration as little as one ppm. Therefore we conclude that sulfur-induced SCC is the cause of the TMI-1 OTSG tube degradation and that it occurred during the cooldown or cold shutdown after the hot functional tests. The same conclusion was stated by the staff consultants through an independent evaluation (Attachments 2-4)." (Emphasis added) (footnote omitted).

6. Further, TMIA contends that there is no assurance that the conditions under which initiation originally occurred have been properly identified. The identification of sulfur as the causative agent required a showing that at ppm levels it could indeed cause rapid SCC under the plant conditions preceding the tube failure. Therefore, extensive efforts were made to identify and verify the conditions under which corrosion initiated and propagated. The results are included in NUREG-1019, Section 3.1 and Topical Report 008, Rev. 3, Section II. All

of the information obtained supports the conclusion that a reduced sulfur species was the causative agent.

7. The remainder of Contention 2.a. simply states that other conclusions are undermined because no assurance exists that the causative agent has been identified. Because, contrary to TMIA's assertion, the causative agent has been clearly identified as a reduced sulfur species, the remainder of Contention 2.a. also lacks technical basis.

8. Additional concerns expressed by TMIA in response to interrogatories are not technically relevant to Contention 2.a. However, they are addressed below for completeness of response.

9. TMIA asserts that the staff ignores Mr. Dillon's comments at page 12 of Attachment No. 3 to NUREG-1019 and rejects his suggestions at page 29 of NUREG-1019. The above two statements by TMIA are inconsistent, because they both refer to the same test, recommended on page 12 of Attachment No. 3. Therefore, the suggestion could not be both "ignored" and "rejected" at the same time. In fact, the recommended test was considered on page 29 of NUREG-1019, in conjunction with the total test program, and deemed unnecessary because it represented a condition which was not applicable to plant operations. Specifically, the recommended test referred to the reactor cleaning process and suggested that a 10.0 ppm sulfate test with oxygen be conducted. The cleaning process has already been completed, with the maximum sulfate concentration reaching only 0.4 ppm (pages 17 and 18 of NUREG-1019, Supplement No. 1). Therefore, the results of the cleaning process and subsequent hot functional testing have demonstrated that the recommended test was not applicable.

10. TMIA asserts that the staff doesn't deal with Dr. McDonald's comments in Attachment 4, pages 18-24, which state that other sulfur species must be present. Also, TMIA asserts that in Attachment No. 4 to NUREG-1019 it is stated that thiosulfate could have been introduced prior to September 1981. Pages 18-24 of Attachment No. 4 discuss a number of aspects of sulfur chemistry, including some of the reduced sulfur species which may have been present. If one reads the last paragraph on page 25 of Attachment 4, it can be seen that the discussion on pages 18-24 was provided to support a recommendation that the reactor coolant system be cleaned (desulfurized). At TMI-1, the reactor coolant system has been cleaned as recommended. The Staff concluded (NUREG-1019, p. 29) that there would not be adverse effects from the cleaning procedure. Therefore, the comments have been dealt with.

11. As for the statement in Attachment No. 4 that thiosulfate could have been introduced prior to September 1981, the Staff does not disagree with this statement. This is also stated at the top of pg. 6 of NUREG-1019. However, it is technically irrelevant because the plant conditions which precipitated the corrosion problem didn't occur until after that date.

12. TMIA, by taking partial sentences out of context, attempts to contend that post-repair testing assumptions are <u>based</u> on a cooldown failure mode (NUREG-1019, p. 32) and on a <u>reliance</u> on ECT to detect cracks during cooldown (NUREG-1019, p. 32). (Emphasis added). Neither of these statements are technically correct. The basis for acceptability of the kinetic expansion repair technique is provided in the Affidavit of Conrad E. McCracken and Jai N. Rajan under Contention 1.a. NUREG-1019

and Supplement No. 1 in their entireties discuss the considerations on which the Staff found the operation with the repaired OTSGs acceptable. A synopsis of these considerations is provided in Section 3.7 of NUREG-1029 and NUREG-1019 Supplement No. 1. At no place is reliance based on any one item to provide the basis for the Staff's conclusion that reasonable assurance exists that the public health and safety is protected.

Conrad E. McCracken

Conrad E. McCracken

Stanley Kirslis

Stanley Kirslis

Subscribed and sworn to before me
this 24th day of February, 1984.

Edythe S. Becker

Notary Public

My commission expires: 7/1/86

S. Stanley Kirslis

Professional Qualifications

I am a Chemical Engineer in the Chemical Technology Section of the Chemical Engineering Branch of the Division of Engineering, Office of Nuclear Reactor Regulation. My duties include evaluation of the compliance of PWR and BWR licensees with the Commission's requirements related to the water chemistry and corrosion aspects of nuclear reactors. I have worked in this position since April 1980.

From 1973 to 1980, I was an Environmental Project Manager in the Division of Licensing, Office of Nuclear Reactor Regulation. From 1960 to 1973, I designed and carried out in-pile tests related mainly to the materials compatibility aspects of the Molten Salt Reactor Experiment at the Oak Ridge National Laboratory (ORNL). From 1953 to 1960, I worked in the Reactor Chemistry Division and the Chemical Technology Division of ORNL, designing and carrying out in-pile tests related to the chemical and nuclear behavior of uranyl sulfate solutions in water at high temperatures (250°F), including the corrosion aspects. From 1943 to 1953, I worked on the Manhattan Project at Columbia University and at the Oak Ridge Gaseous Diffusion Plant on uranium and fluorine chemistry and on gaseous diffusion theory. From 1942 to 1943, I worked as an analytical chemist at the Alabama Ordnance Works. From 1941 to 1942, I worked in chemical analysis at Lever Bros. Co. in Cambridge, Massachusetts.

Education: B.S., Harvard College, 1941

Ph.D in Physical and Inorganic Chemistry, University of Tennessee, 1953