AFFIDAVIT OF ROBERT D. POLLARD

I, Robert D. Pollard, having been sworn, make my affidavit as follows:

I. Professional Qualifications

1. My name is Robert D. Pollard. I am presently employed as a nuclear safety engineer with the Union of Concerned Scientists (UCS), a position I have held since February 1976. Before coming to UCS, I spent 6 1/2 years with the Atomic Energy Commission and the Nuclear Regulatory Commission where I rose to the position of Project Manager, with responsibility for the overall safety review of a number of nuclear power plants. A complete statement of my professional qualifications is attached to this affidavit.

II. Purpose

2. The purposes of this affidavit are: a) to explain the safety significance of hydrogen control measures for nuclear power plants, and b) to explain how the recent NRC Policy Statement[1] will unreasonably preclude parties to NRC licensing proceedings from attempting to demonstrate that NRC's treatment of the hydrogen control issue is not adequate to protect the health and safety of the public.

III. Hydrogen Control Measures

3. Following a loss-of-coolant accident in a light water reactor, hydrogen will be produced. One of the principal sources of hydrogen is an exothermic chemical reaction between the zirconium metal used as cladding for the uranium fuel rods and the water (or steam) remaining in the reactor vessel. The accumulation of hydrogen gas in the reactor containment building poses the threat of an explosion that could rupture the building and result in the escape of large amounts of radioactive materials to the environment.

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[1] "Further Commission Guidance for Power Reactor Operating Licenses," Statement of Policy, June 16, 1980. (hereinafter "Policy Statement")

4. The hydrogen control measures used in nuclear power plants to prevent the accumulation of explosive quantities of hydrogen fall into two main categories: reducing the amount of hydrogen produced and preventing the explosion of the hydrogen that is produced.

5. The amount of hydrogen produced by the metal-water reaction involving the fuel rod cladding is directly proportional to the amount of cladding which reacts. By limiting the temperature rise of the fuel rod cladding following an accident, the amount of cladding that would otherwise react with water to produce hydrogen can be reduced. Current NRC regulations require that emergency core cooling systems be designed such that "[t]he calculated total amount of hydrogen generated from the chemical reaction of the cladding with water or steam shall not exceed 0.01 times the hypothetical amount that would be generated if all of the metal in the cladding cylinders surrounding the fuel...were to react." 10 CFR 50.46 (b)(3). In other words, safety system performance should permit no more than 1% of the cladding to react with water to form hydrogen. However, during the accident at Three Mile Island Unit 2 which began on March 28, 1979, approximately 30 - 50% of cladding reacted with water to form hydrogen.

6. Even assuming that the amount of hydrogen produced by the metal-water reaction were limited to 1% of the cladding, the other principal category of hydrogen control measures (preventing the explosion of the hydrogen produced) is still required by NRC regulations. (10 CFR 50.44, "Standards for Combustible Gas Control Systems in Light Water-Cooled Power Reactors.") In summary, these regulations require that the hydrogen control systems be of sufficient capacity to protect the public in the event that degradation, but not total failure, of the emergency core cooling systems results in producing five times the total amount of hydrogen calculated without such degradation, up to a maximum of 5% of the cladding. The hydrogen control systems at Three Mile Island Unit 2 were, therefore, not sized to prevent combustion of hydrogen if more than 5% of the cladding reacted.

III. Action Needed

7. During the accident at Three Mile Island Unit 2, the plant safety systems did not limit the amount of cladding involved in the metal-water reaction to less than 1% of the cladding as required by 10 CFR 50.46 (b)(3). Approximately 30 - 50% of the cladding reacted to form hydrogen. The hydrogen control systems, sized to meet the requirements

of 10 CFR 50.44, were of insufficient capacity to prevent the subsequent explosion of the hydrogen.

The explosion did not rupture the containment at TMI-2 because the peak pressure generated (approximately 30 psig) was less than the design pressure of the building. However, had more or all of the cladding reacted, the result might have been an explosion of sufficient size to rupture the containment.

Furthermore, the same accident sequence and the same 30 - 50% caldding reaction at another plant could rupture its containment. In a smaller containment building, the pressure resulting from the explosion would be higher than 30 psig and containments for boiling water water reactors and some pressurized water reactors have a much lower design pressure than for plants such as TMI-2. Some have a design pressure as low as 12 - 15 psig.

8. To prevent similar and more severe addicents in the future, it is my opinion that a variety of actions need to be taken. First, to limit the amount of hydrogen that can be produced during an accident, there are several possibilities. The type of metal used as fuel rod cladding could be changed to one that does not undergo the chemical reaction with water. The emergency core cooling systems could be redesigned to provide greater cooling capability

and to prevent operators from terminating or reducing the cooling water flow until automatic instruments determined that it was safe to do so.

Second, to provide adequate hydrogen control systems to prevent explosion of the hydrogen produced, there are likewise a number of alternatives to consider. The NRC regulations could be changed to require hydrogen control systems to be designed on the assumption that 100% of the cladding reacts with water to produce hydrogen. The containment atmosphere could be required to be inerted, that is, the air could be replaced with nitrogen. If the atmosphere was oxygen deficient, the hydrogen could not explode.

9. The preceeding examples of the methods that could be used to limit the amount of hydrogen produced following an accident and prevent the explosion of the hydrogen which is produced are not an exhaustive list of the methods available.

IV. Effect of NUREG-0660[2] and NUREG-0694[3]

10. NUREG-0660 or the "Action Plan" describes the new safety requirements and further research that, in the NRC's view,

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[2] U.S. Nuclear Regulatory Commission, "NRC Action Plan Developed as a Result of the TMI-2 Accident," NUREG-0660, May 1980.

[3] U.S. Nuclear Regulatory Commission, "TMI-Related Requirements for New Operating Licenses," NUREG-0694, June 1980.

are needed as a result of the TMI-2 accident. Many of these actions are of long-term nature. That is, a subject requiring study is described and a project of years-long duration to study that subject is begun.

11. NUREG-0694 delineates which of the actions in NUREG-0660 should, in the NRC's view, be completed before new operating licenses are issued.

12. One of the actions related to limiting the amount of hydrogen produced during an accident is described in NUREG-0660, Task II.B.5, "Research on phenomena associated with core degradation and fuel melting." The NRC acknowledges that "there are critical phenomenological unknowns or uncertainties that impact containment integrity assessments and judgements regarding the reliability of certain mitigating features."[4] The unknowns and uncertainties include "the behavior of severely damaged fuel, including... hydrogen generation,...and the effect of potential hydrogen burning and/or explosions on containment integrity."[5] The hydrogen studies will also include "a review of means of handling accident-generated hydrogen, with

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[4] NUREG-0660, p. II.B-4.

[5] Id.

recommendations on improving current methods."[6] The present schedule for this research extends through September 1982.[7]

13. One of the actions related to developing methods to prevent explosion of the hydrogen is described in NUREG-0660, Task II.B.8, "Rulemaking proceeding on degraded core accidents." The present schedule is to publish an interim rule by July 1980 and to publish a final rule two or more years later.[8] For the interim rule, the NRC "will consider whether, in the course of the long-term rulemaking, all licensees hold construction permits or operating licenses should be required by the interim rule to provide conceptual designs for...a hydrogen control system for heir plants."[9] It is clear, then, that NRC intends to allow new plants to be licensed for operation without the improved hydrogen control measures which are, in my opinion, necessary to protect public health and safety.

"The long-term rulemaking will go beyond the interim rule and include consideration of...hydrogen control measures to deal with accident conditions involving large amounts of

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[6] NUREG-0660, p. II.B-5.

[7] *Id*. at II.B-7.

[8] *Id*. at II.B-10.

[9] *Id*. at II.B-11 (Emphasis added)

hydrogen generation..."[10]

14. The effect of NUREG-0660 insofar as it relates to limiting hydrogen production and controlling the hydrogen which is produced is to acknowledge the unknowns and uncertainties involved but to permit new plants to be licensed for operation without resolving those unknowns and uncertainties and without requiring adequate hydrogen control measures.

V. Effect of NRC Policy Statement

15. The Commission's Policy Statement of June 16, 1980 (published in the Federal Register on June 20, 1980) concludes that the "list of TMI-related requirements for new operating licenses found in NUREG-0694 is necessary and sufficient for responding to the TMI-2 accident."[11] The Commission also decided that licensing boards "may not entertain contentions asserting that supplementation is required."[12] Applicants for licenses, in contrast, are expressly permitted to challenge the necessity of any new requirement contained in NUREG-0694.[13]

16. The effects of this policy statement are: a) requirements

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[10] Id.

[11] Policy Statement, p.5.

[12] Id. at 8.

[13] Id. at 7-8.

for safety improvements and results of research identified as necessary by the NRC in NUREG-0660 but not listed in NUREG-0694 will not be required on new operating licenses; and b) parties to licensing hearings will be prohibited from attempting to demonstrate that actions in NUREG-0660 or actions different from those in NUREG-0660 are necessary to protect the health and safety of the public.

VI. Conclusions

17. On the basis of my knowledge of nuclear power plant safety systems, NRC's current regulations, and the TMI-2 accident, I conclude that the TMI-2 accident demonstrated that current NRC regulations relating to hydrogen control measures are not adequate to ensure the health and safety of the public.

18. I also conclude, on the same basis, that the actions required in NUREG-0694 related to hydrogen control do not correct the deficiencies in the NRC regulations. In my opinion, the issuance of new operating licenses without adequate provision for hydrogen control would pose an undue risk to public health and safety.

19. Therefore, I conclude that the NRC policy statement unreasonably precludes parties to licensing proceedings from attempting to demonstrate that NRC's treatment of

the hydrogen control issue is not adequate to protect the health and safety of the public.

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I, Robert D. Pollard, hereby affirm that the foregoing facts are true and accurate to the best of my knowledge and belief.

Robert D. Pollard

Sworn to and subscribed before me this 18th day of July, 1980.

NOTARY PUBLIC

My Commission Expires December 14, 1984

ROBERT D. POLLARD
QUALIFICATIONS

Mr. Pollard is presently employed as a nuclear safety expert with the Union of Concerned Scientists, a non-profit coalition of scientists, engineers and other professionals supported by over 80,000 public sponsors.

Mr. Pollard's formal education in nuclear design began in May, 1959, when he was selected to serve as an electronics technician in the nuclear power program of the U.S. Navy. After completing the required training, he became an instructor responsible for teaching naval personnel both the theoretical and practical aspects of operation, maintenance and repair for nuclear propulsion plants. From February, 1964 to April, 1965, he served as senior reactor operator, supervising the reactor control division of the U.S.S. Sargo, a nuclear-powered submarine.

After his honorable discharge in 1965, Mr. Pollard attended Syracuse University, where he received the degree of Bachelor of Science magna cum laude in Electrical Engineering in June, 1969.

In July, 1969, Mr. Pollard was hired by the Atomic Energy Commission (AEC), and continued as a technical expert with the AEC and its successor the United States Nuclear Regulatory Commission (NRC) until February, 1976. After joining the AEC, he studied advanced electrical and nuclear engineering at the Graduate School of the University of New Mexico in Albuquerque. He subsequently advanced to the positions of Reactor Engineer (Instrumentation) and Project Manager with AEC/NRC.

As a Reactor Engineer, Mr. Pollard was primarily responsible for performing detailed technical reviews analyzing and evaluating the adequacy of the design of reactor protection systems, control systems and emergency electrical power systems in proposed nuclear facilities. In September 1974, he was promoted to the position of Project Manager and became responsible for planning and coordinating all aspects of the design and safety reviews of applications for licenses to construct and operate several commercial nuclear power plants. He served as Project Manager for the review of a number of nuclear power plants including: Indian Point, Unit 3, Comanche Peak, Units 1 and 2, and Catawba, Units 1 and 2. While with NRC, Mr. Pollard also served on the standards group, participating in developing standards and safety guides, and as a member of IEEE Committees.