

**Reportable Event Report on Maanshan Nuclear Power Plant Unit 2  
Steam Generator Low-Low Level Scram  
(RER-94-32-001)**

1. Description of Event

On January 29, 2005 Maanshan Nuclear Power Plant Unit 2 was operating at 95% capacity and generating 893MWe. At 11:25 pm a reactor scram was initiated followed by trip of the main turbine. After the scram, the reactor safety systems and equipment operated according to design function and no abnormality occurred.

2. Cause of Event

The cause of this reactor scram event was that the Solid State Protection System (SSPS) universal logic card (No. A316, low-low water level signal for the steam generators) malfunctioned (there was, in fact, no low-low water level condition) as shown in the diagram. This then caused the actuation of the Auxiliary Feed Water System (AFWS)/Train B and Reactor Protection System.

3. Analysis of Cause and Corrective Measures

This incident was the result of a malfunction of the A316 universal logic card SSPS/Train B that led to the reactor scram. The basic function of the universal logic card is to produce a specific output control signal after the logical processing of differing input signals causing the reactor scram or to actuate safety equipment. The malfunctioned card was developed and manufactured by the Chung Shan Institute of Science and Technology (CSIST) and was dedicated by the Institute of Nuclear Energy Research.

The cause of the malfunction and follow-up corrective measures are as follows:

(1) Malfunction Identification

After the reactor scram, the continuing sound of a relay click in Train B JP059 output cabinet of the SSPS could be heard in the control room. Upon investigation

it was discovered that the master relay K515 and the slave relay K640 were clicking intermittently, and at the same time the UV coil's voltage meter was oscillating between 0~48 Vdc. Normally when there is no trip signal the voltage is 48 Vdc and when there is a trip the voltage is at 0 Vdc. At the time, the reactor was shutdown with no trip signal and the UV coil meter should have been showing 48 Vdc. The voltage oscillating from 0~48 Vdc and the sound of the relay click were abnormal phenomena.

When measured with a multi-meter, the universal logic card A316 (O<sub>1</sub>) showed a voltage of 0.6 Vdc (Logic 1). Normally the voltage should be 14.78 Vdc. This voltage value showed that the universal logic card A316 was giving a trip signal, which was the signal for the reactor trip breaker and the motor-driven AFWS/Train B to be actuated.

## (2) Analysis of the Cause

Logically, the possible causes for sending the erroneous trip signal by the universal logic card A316 are: 1) the A316 card itself failed, or 2) the A316 card had problems in the input/output signal. During the investigation following the incident, however, the failure of the card could not be reproduced. Perhaps the cause of the failure was eliminated or disappeared when the A316 card was pulled out.

## (3) Corrective Measures

Taipower has taken the following measures with regard to the cause of the equipment failure:

- 1) Examination of the A316 card slot and all the input/output solder connections in the equipment cabinet with an electron microscope to confirm there was no abnormality.
- 2) A renewed examination of the correctness of all input/output connections of the A316 card.

- 3) Change of the A316 card and all the input/output cards in series, including four universal logic cards, A316, A409, A410 and A415, as well as the safeguard output A518 card. Also the 600-I-SB-1002 test procedure (reactor protection system Train B logic circuits bi-monthly test) was carried out to ensure that the SSPS/Train B equipment was normal and operable.
- 4) The five replaced cards were sent to the CSIST for a high temperature screening test to identify the faulty part of the card.
- 5) Installed a recorder that continuously monitors the input/output signal of the A316 card.

#### 4. The Operation of Safety Systems

Given the strict requirements for nuclear safety controls, AEC regards any automatic reactor scram of nuclear reactor units as a serious incident which requires approval for restart. Since the operation of all safety systems is likely to be involved during the process of an automatic reactor scram, each shutdown becomes an excellent opportunity to inspect and examine the function of safety equipment. During the process of shutdown, the operation of each safety system as well as the relevant parameters was carefully examined, and it was assured that the reactor safety systems all operated normally and there was no safety concern and no environmental impact outside the plant.

#### 5. AEC Regulatory Measures

On January 29, immediately after Taipower notified AEC of this incident by phone, the Council immediately inquired the condition of the reactor units and was assured that the unit had safely shut down. Also, the AEC resident inspectors were notified to investigate the cause of the reactor scram as well as follow-up corrective activities on site. Upon completion of the investigation, Taipower came to AEC headquarters on January 31 to present the cause of the shutdown and proposed corrective measures that had to be completed. Taipower further submitted a request to AEC for a restart in

accordance with established restart regulations. After careful review, AEC determined that there were no safety concerns. With imposed follow-up regulatory requirements, AEC agreed to allow restart of the reactor at 5:30 pm on January 31.

