ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

November 24, 1965

Honorable Glenn T. Seaborg
Chairman
U. S. Atomic Energy Commission
Washington, D. C.

Subject: REPORT ON THE POWER BURST FACILITY

Dear Dr. Seaborg:

At its sixty-eighth meeting, November 10-12, 1965, the Advisory Committee on Reactor Safeguards considered the proposal of Phillips Petroleum Company to construct the Power Burst Facility (PBF) at the National Reactor Testing Station. The Committee had the benefit of discussions with representatives from Phillips Petroleum Company and the AEC Staff, and of the documents referenced below. A Subcommittee reviewed the proposal on November 3, 1965.

The reactor is designed to be capable of generating self-limiting power bursts with peak power levels up to about 350×10^9 watts and with initial periods as short as one millisecond. The total core energy release associated with the bursts is expected to be as large as 3000 Mw-sec. The principal purpose of the facility is to provide, without damaging the driver core, large neutron bursts within a central test section in which experimental samples, fuel elements, and clusters of fuel elements can be heated to failure.

The reactor has a steady state heat removal capacity of 20 Mw, but it will be run at such powers only for brief periods in connection with the experimental program.

The core will be about 52 inches in diameter with an active height of 36 inches. It will be supported in a water filled open tank 15 feet in diameter and 28-3/4 feet deep.

Cooling is provided by forced circulation of water through the core. The reactor is regulated by eight control rods. In addition, four pneumatically driven transient rods are provided to initiate self-limiting power bursts. The reactivity insertion rates may be varied up to a maximum rate of \$150/sec. The maximum temperature of the core fuel will be limited to temperatures less than the melting point of the fuel pellets (about 2450° C).

The present fuel rod design consists of 304 stainless steel outer clad, an inner zirconia sleeve, and pellets of UO_2 and calcia-stabilized zirconia (ZrO_2 - CaO).

The central experimental region will accommodate a pressurized water loop with a heavy walled in-pile section. The first loop will be designed for operating conditions of 2250 psig and 650° F. An external cooling system will provide for removing 500 kw from the loop experiment. A loop clean-up system will be provided to accommodate fission products which might be released from destructive experiments in the loop. Other coolants have been mentioned for possible use in the central loop, but no designs are available, and the safety of operation with such loops was not reviewed at this time.

Representatives of Phillips Petroleum Company stated that autocatalytic reactivity effects are associated with the loss of water from the loop, and care must be taken to limit the reactivity which could result from voiding the loop.

Core and loop structure will be exposed to peak fluxes of 10^{13} n/cm^2-sec during bursts, and the Phillips Company will look into possible undesirable effects of such fluxes during its development program.

Careful analysis of the possibility of loop failure must be made prior to the acceptance and performance of specific experiments. Representatives of the Phillips Company stated that it will develop an overall group of criteria on which to judge the acceptability of experiments.

It should be noted that the fuel elements proposed for use in the PBF core are still under development. Although tests have been run at the TREAT Reactor and during the KIWI-TNT experiment, the design has not been frozen and further testing programs are planned.

It is planned to use a "lead element" approach in which typical fuel elements are thoroughly tested in the experimental region under more extreme conditions than the elements in the PBF core.

Approach to the maximum burst conditions will be made in a gradual, step-wise fashion. It must be recognized that problems may develop which preclude obtaining the maximum burst condition for which PBF is designed. This could result from uncertainties in the Doppler effect, from limitations imposed on available reactivity due to the consequences of major reactivity accidents, from the possibility that various modes of fuel failure lead to serious core damage or autocatalytic contributions to reactivity excursions.

Since a reactivity excursion considerably beyond that planned will free the bulk of the radioactivity tied up in the core and the experimental section, the Phillips Company proposes to strictly limit the inventory of radioactivity in the core plus experimental loop, and not to perform experiments on plutonium fuel elements.

It is recognized that the potential of an accidental release of fission products is far greater in the PBF than in more conventional test facilities or power reactors. Careful plans for evacuation of the site personnel from the control center must be made and kept in operation.

Because of the low fission product inventory and the care being taken to provide for adequate evacuation of the site personnel, the Advisory Committee on Reactor Safeguards believes that the proposed facility can be constructed and operated without undue risk to the health and safety of the public, in spite of the relatively high likelihood that a fission product release may occur.

Sincerely yours,

/s/
W. D. Manly
Chairman

References:

1. IDO-17060, Preliminary Safety Analysis Report, Power Burst Facility and Revised Pages VI-12, 13 and 26, received August 2, 1965.

2. Additional Information Provided for Safety Review of the PBF dated October 13, 1965.