Pumps, instrument tubing main trouble spots in NPD startup.

The diagram below shows the eleven steps to full-power operation of NPD, whose smooth run-up has attracted wide favorable comment. They were described to the Eighth Atomic Power Symposium by L. G. McConnell of Ontario Hydro. The presentation also frankly detailed the difficulties which had been experienced due to defects in equipment, design and operating methods.*

The largest single problem described by McConell was the high percentage of faults in the 25,000 mechanical tube joints in the complex of instrument tubing required by the moderator flow and temperature control systems. "Several thousand of these fittings had to be replaced due to faulty workmanship. We now recommend a minimum number of such joints and the same degree of quality control as is used in welding" he stated. Corrosion of the instrument tubing was also a problem, where the tubes had been cast into the concrete of the structure. Free water caused severe corrosion and tube failure. No less than 200 tubes had to be replaced because of this.

Gas-locking of moderator and charging pumps was another problem causing poor pump performance and high heavy water inventory. Two remedies were needed. Changing dump tank configuration solved the problem for the moderator pump. Degassing facilities had to be provided ahead of the charging pumps.

Mechanical shaft seals on the primary heat transport pumps also provided difficulties which had to be corrected. Seal life at full power is still short, and "a very intensive development program is under way with the objective of achieving a one- to three-year life per seal replacement."

As the diagram indicates, commissioning was divided into four phases. Little difficulty was encountered in the first, or pre-critical phases. The low-power measurements following criticality on April 11 substantially confirmed the design data, (see table) except that an overestimation was made of the effect of depleted uranium which had been charged to permit early operation at full power. According to the paper "the fuelling machines were subsequently used to adjust the depleted uranium and the reactor physics has now been essentially reconciled."

Power run-up apparently went "quite smoothly" and no major difficulties are described. Time from first generation to full power was just over three weeks. Unofficial reports of difficulties with excessive turbine vibration during run-up were apparently exaggerated; the report mentions only temporary difficulties due to faulty lubrication of one bearing.

In conclusion, it is pointed out that full power operation is still intermittent, and "certain equipment which is not as reliable as we wish is being perfected in preparation for continuous operation." In addition, it is noted, station stability is still being tested by various experimental procedures. ■

COMPARISON OF NPD DESIGN AND MEASURED PARAMETERS

Parameter	Design Value	Measured Value
Clean critical level	*89.3 inches	97.5 inches
Moderator temp. coefficient	–0.06 mk/°F	–0.04 mk/°F
Heat-transport system temp. coeff.	–0.024 mk/°F	–0.02 mk/°F
Light-water reflector savings	3 mk	3.6 mk
$\frac{\Delta k_{eff}}{k_{eff}}$ clean critical to full tank	37 mk	39 mk
$\frac{\Delta k_{eff}}{k_{eff}}$ for enriched booster	2.5 mk	2.4 mk
Dump rate ($\frac{\Delta k_{eff}}{k_{eff}}$ in first second)	**3 mk	5 mk

* Error due to underestimate of depleted uranium — now reconciled.

** Conservative value — measured results more favorable.

* Mr. McConnell is presenting a paper on "Commissioning and initial operation of NPD" to the Washington meeting of ANS, Nov. 26. A summary only of his remarks to the Symposium has been released. All quotations are therefore taken from this summary.