Many uncertainties in storing nuclear wastes

A draft report on storing high-level radioactive wastes points to numerous uncertainties about the safety of burying wastes in underground salt or rock formations — the two concepts currently in favor. Most of the uncertainties involve a lack of knowledge about potential geochemical, geophysical or hydrological interactions between the wastes and the geologic structure in which they might be stored, according to the report, prepared by the President's Office of Science and Technology Policy.

These "gaps in our current knowledge need not rule out successful underground containment of [wastes] for many thousands of years," say the authors. However, data they indicated would be necessary for establishing safe site-selection criteria were described as being "years away" in many instances. They say it may be necessary to run *in situ* tests or even to construct and operate a nuclear-waste repository for a decade or more to learn which of these uncertainties are important and to what extent. For this reason, they recommend that greater emphasis be placed on conducting critical tests in areas that qualify as site candidates.

The form in which wastes are buried presents one set of uncertainties. One currently popular concept, for example, would seal wastes in a borosilicate glass, which is then placed in a steel container and sealed in rock. Some highly soluble phases are produced as the glass devitrifies (reverts out of its glass state), they say. And they refer to work by Gregory J. McCarthy of Pennsylvania State University, reported in the May 18 NATURE, which indicates that some of these glass-like substances would break down within only a few weeks or months if they came into contact with groundwater during the first 100 or so years of burial.

The OSTP report says it will probably take three to five years to understand the range of chemical reactions likely to occur between "candidate waste forms" (such as glass encapsulation), the containers and the chosen rock formation. How and to what extent the integrity of the rock barriers are altered by heat and radiation emitted by stored wastes is but another of the sets of uncertainties described in the OSTP report.

The government has a history of ignoring geology when siting nuclear-waste repositories, according to Warren W. Wood of the United States Geological Survey. At a recent meeting of the American Geophysical Union, Wood described a study his agency made of five of six existing low-level waste sites in the United States. One by one he went down the list citing specific geological characteristics that ultimately made each unacceptable. The sites were chosen for reasons other than geology, he said, but in the end geology will play one of the most important factors in determining whether interred wastes leach into the soil or groundwater. □

Skylab: More uncertainties

The huge Skylab workshop, essentially a multi-room house in space, continues to orbit the earth, as ground-bound researchers struggle with the problem of its uncertain future: Will space-shuttle astronauts be able to get there in time to boost the space station to a higher, longer-lived orbit, or will it be dragged down by the atmosphere to a fiery demise with the possibility of major fragments surviving to strike the earth's surface? Hopes had begun to look a little brighter on June 11, when Skylab responded to radioed commands by moving into a position that minimized the drag of the atmosphere. Developments since then, however, have made the prognosis less certain than ever.

One of the two key factors is Skylab itself, which pleasantly surprised NASA by responding to commands more than four years after being initially shut down, but which will also have to keep responding for at least another 16 months (or more) until astronauts can reach it. The other factor is sunspots, an indicator of solar activity that correlates with conditions in the earth's upper atmosphere, and whose predicted increase is thus a vital factor in calculating how soon Skylab's decaying orbit will descend past the point of no return.

The plan to prevent the space station's uncontrolled reentry calls for astronauts to carry a specially designed rocket motor up with them in the shuttle, steer the rocket by remote control to a docking with Skylab, and then fire it to move Skylab into either a higher orbit or, less likely, a controlled reentry so that any fragments would fall into the ocean. NASA administrator Robert Frosch estimated (on the July 12 MacNeil/Lehrer Report) that there is a 1 in 3 chance of the station's still being there by the time the astronauts are able to reach it, and Congress has released the beginnings of the nearly $40 million that the remote-control rocket is expected to cost. But those odds, while they acknowledge that the mission is viewed as a bit of a long shot, fail to indicate the growing difficulty of even "guesstimating" the real chance of success.

Since the success of the June 11 reorientation maneuver (SN: 6/17/78, p. 388), for example, several things have gone wrong aboard the orbiting facility. First Skylab moved out of its low-drag position and wasted some of the gas in its attitude-control system. This was tentatively analyzed as a pair of malfunctioning switches and circumvented. Then the station began swinging back and forth in ever-widening arcs in one of its axes, which was dealt with by reprogramming an on-board computer. Then two battery-charger regulators malfunctioned, causing one of Skylab's two sets of batteries to shut itself down from the overload. Controllers at the NASA Johnson Space Center in Houston were dealing with that problem this week, while preparing to attempt to re-stabilize the station in its low-drag position.

Insofar as is currently understood, none of these "glitches" is individually catastrophic. Their collective message, however, is that Skylab will require considerably more attention than was previously anticipated. It is the difference, says one NASA official, between being able to "set it and forget it" and having to "fly it by hand." As a result, NASA is having to add a third shift of mission controllers at JSC, so that flight teams will be on duty 24 hours a day, seven days a week. In addition, a tracking station in Santiago, Chile, is being added to the ones in Madrid, Bermuda and Goldstone (Calif.) that currently monitor Skylab, so that the orbiting workshop will never be out of contact with the ground for more than 90 minutes a day, in contrast to the present gaps of as much as seven hours. The Santiago station thus needs new VHF communications gear and another computer, and JSC is also installing an additional computer to process high-speed data.

There is, however, another side to the question of keeping Skylab up: the increasing tendency of the atmosphere to pull it down. The sun is approaching a maximum in its 11-year cycle of activity, which produces — through mechanisms that are far from fully understood — corresponding effects in the earth's upper atmosphere, causing its fringes to extend outward to where they increase the drag on the space station. The number of sunspots is an indicator of how active the sun will be at a given maximum, but predicting that number is an iffy process — and it has just become iffier.

The space agency based its original prediction on a comparison of the rate of increase of the number of sunspots in the past 20 solar cycles, which yielded a predicted maximum of 76. Late in 1976, scientists at the National Oceanic and Atmospheric Administration began making predictions with a similar method, but using only the last 13 cycles, since there is some question about whether the previous seven cycles, which occurred some two centuries ago, were reliably documented. The NOAA prediction was about 120, which is when fears began to arise that Skylab might reenter too soon for salvation, unlike NASA's hopes at the time of the station's deactivation that it would stay up until 1983 or 1984. The geomagnetic effects associated with earth's atmospheric re-