Europe's nuclear fuel cycle: a bottleneck to economic growth

by William Engdahl

On June 5, Japan's Ministry of International Trade and Industry (MITI) announced its plans to construct an additional 40 nuclear power reactors in Japan, doubling the present capacity of electric generation from nuclear sources. The rapidly growing Asian economies of South Korea, Taiwan, and, most recently, Indonesia, have all moved to institute significant new nuclear programs in recent months. Yet the nuclear requirements of the emerging economies of Eastern Europe—presently choking in inefficient and filthy lignite coal power plants—are just beginning to be assessed as a vital component of strong, rapid industrial modernization.

The requirements of new nuclear plant capacities worldwide, and immediately in the western part of Europe, will very soon become a critical bottleneck to future industrial growth (see *EIR,* April 27, 1990, "Nuclear energy base crucial to European industrial reconstruction"). We review here Europe's critical nuclear fuel cycle capacities, the elements in the process without which not a single watt of nuclear electricity would exist. This review leaves aside the question of more advanced technologies that are also required, such as the fast breeder reactor and fusion power.

According to data from the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD), in 1990 the world will produce only slightly more uranium than nuclear reactors will consume. Fifteen years ago the United States was the world's largest uranium mining producer and the world's largest commercial reprocessor. Today, the United States is the world's largest consumer of uranium fuel, with 107 gigawatts-electric (GWe) of operating reactors. But owing to federal government environmental policy and refusal to regard uranium mining as a vital strategic interest, the country has little control of its own uranium supply and processing.

In terms of supplies of "yellowcake" (a mixture containing 75% uranium), the U.S. firm Energy Resources International estimates that for the next 5-10 years, the 1980s trend of "excess uranium supply" will continue, with the biggest demand question being the rate of expansion of nuclear capacities in Western Europe. Because of the numerous nuclear plant cancellations in recent years, OECD countries have been left with a backlog of uranium stock equal to some four years' consumption, which has resulted in a price collapse from the highs of $36-40 per pound for yellowcake in the mid-1970s, down to about $10 per lb. today. The effect of this price collapse has been to drive numerous U.S. and other uranium mines out of business, leaving the rest cartelized in the hands of a tiny number of global giants, such as London's Rio Tinto Zinc.

Uranium ore processing

The emerging economies of Eastern Europe desperately need a significant increase of electric generating capacity and—for real environmental considerations as well as economic ones—must turn to clean, safe, and efficient nuclear generation. They will need to purchase much of this from Western Europe, and the constraints of the present uranium ore-processing capacity in the West are significant in this respect.

Western Europe today has the following capacities for processing uranium ore (measured in tons of uranium oxide—U_3O_8—per year):

Belgium: 50
France: 5,410
West Germany: 125
Greece: 150
Spain: 830
Total European Community: 6,565

In 1988, total non-communist world uranium ore-processing requirements were almost exactly equal to capacity, a dangerous state, to say the least. This demand totaled 46,000 tons of U_3O_8 per year. This capacity tightness had been only somewhat improved by 1990, with new capacity being added, but in the context of large, new nuclear plant orders in Europe of 75-250 GWe over the next decade and a half, we simply do not have at present sufficient uranium ore-processing capacity in the world. With construction lead times of an estimated seven years to build new ore-processing plants, it is urgent to begin this now. The European nuclear industry today has made clear that it must have government assurances that it will not be bankrupted by Green sabotage or legal wrangles, if it is to make such a new and costly commitment, as with all aspects of the nuclear fuel cycle, including revival of a broad-based European fast breeder and a high temperature gas-cooled reactor (HTGR) development program as the next generation.

Uranium refining and enrichment

Out of total world uranium-refining capacity, France and the United Kingdom held 41% (as of July 1989). This breaks down as follows (measured in tons of U_3O_8 refined per year into uranium hexafluoride—U_6F):

France:
- Pierrelatte (NatU): 14,000
- Pierrelatte (RepU): 350
- Malvesi: 14,000

United Kingdom:
- Springfields: 11,200

Total European Community: 39,550

Uranium for use in light water reactors must have concentration of fissionable U-235 to a level of 3.5-5%, depending on the design of the reactor. Enrichment is measured in Separative Work Units (SWUs). Worldwide present enrichment capacity for civilian fuel is 35 million SWUs per year. Of this, 19 million, or about half, is in the United States, in a program run by the Department of Energy—an incredibly bungled operation which is losing its world monopoly by overcharging and mismanagement.

As of Jan. 1, 1989, when the new U.S.-Canada Free Trade Agreement went into effect, Canadian uranium became exempt from U.S. Atomic Energy Act restrictions that block import of enriched uranium for U.S. reactors. This means a major boost to Canadian and British enrichment markets and a probable further closing of U.S. capacity.

We mention this, because it bears on the issue of demand for European enrichment capacities. The United States has recently shut down 29% of its enrichment capacity—9 million SWU worth—further driving U.S. electric utilities onto the European market for long-term contract supplies. The U.S. Department of Energy has, as a result, lost a major share of its previous contracts to enrich uranium for Western European nuclear reactors, placing further demand pressures on existing European Community (EC) enrichment capacities. Given the U.S. budget uncertainties in the coming several years, it would be a prudent assumption that U.S. enrichment capacities will not be a very reliable source for needed enrichment, in face of an expanding European demand.

Here is what presently exists in EC uranium enrichment capacity (measured in SWU per year):

France: 10,800,000
West Germany: 450,000
Netherlands: 1,200,000
United Kingdom: 950,000
Total European Community: 13,400,000

This represents 31% of total world enrichment capacity of 43,705,000 SWU per year. If we exclude the special case of the 10,000 SWU per year of Soviet capacity, the EC share of enrichment capacity is fully 40% of the Western world's capacity. The U.S. capacity at present is 19,130,000 SWU per year. If that is closed in any significant way for budget reasons, we have a world enrichment capacity crisis at hand. Current U.S. nuclear industry requirements alone are for 10 million SWU per year. With only their current plants under construction, in several years France and Japan will each require some 6 million SWU by the mid- to late-1990s. Given the growing geopolitical uncertainties, the Japanese government recently stepped up plans for its own domestic enrichment capacity, but this will at best give only 1.5 million SWU by end of this decade.

World enrichment demand versus capacity today is in slight surplus, but only slight. As of OECD data from July 1989, capacity was expected to exceed demand annually in 1990 by 14 million SWU per year.

The death knell last year for the Wackersdorf nuclear reprocessing facility in West Germany eliminated with it the prospects of reprocessing spent fuel rods to meet this demand. Current expansion of capacity is, however, planned by France's Eurodif and the U.K.-Dutch-German Urenco consortium, which has enrichment facilities in operation at Capenhurst in the U.K. and Almelo in the Netherlands.

Given the recent U.K. government decisions regarding nuclear industry and electricity privatization, British participation in such future plans are somewhat doubtful. British Nuclear Fuels (BNFL) is a member of the Urenco consortium.

One very promising area being pursued in France and, at least until recently, in Germany, has been laser enrichment techniques to replace aging gas diffusion capacities. Under the AVLIS method—which was originally developed in the United States, at Lawrence Livermore National Laboratory—U-235 atoms can be selectively "excited" by existing high-power copper vapor lasers, and then electromagnetically extracted. There remain technical materials handling problems with this promising new enrichment method, including use of materials which resist corrosion with uranium at 2,500° Kelvin.

There is also another avenue for future enrichment using laser-catalyzed chemical reactions, known as CRISLA. Developed by the firm Isotope Technologies in California, CRISLA may become economical in low-level enrichment of uranium for power plants using an infrared carbon dioxide laser. The energy requirements to drive this type of separation process in laboratory results are some 300 times less than the conventional energy-intensive diffusion techniques. If diffusion consumes 2,500 kilowatt hours (kWh) per SWU, CRISLA consumes 10 kWh per SWU and AVLIS some 40 kWh per SWU. Ultracentrifuge consumes some 50 kWh per SWU.