SERVICES ON NUCLEAR ENGINEERING

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The following text describes the specialized services that were performed in the nuclear engineering field, mainly considering activities directly related to cores of nuclear reactors; waste management; thermal and hydraulics and safety analysis of plants and systems. The technical expertise of our professionals in the above specialties is directed to solve problems related to conceptual design, operation, nuclear fuel design and performance evaluation, life extension, reliability and safety analysis. A brief description of the relevant activities are summarized bellow:

Thermal and hydraulics - Core thermal design of pool type reactors; development of experimental setups to measure thermal and hydraulics parameters of plate type fuel elements; determination of power and temperature safety limits of experimental reactor cores; analysis of the specification of a heated rod setup for burnout studies; and participation in the design and analysis of the pressurizer of IRIS reactor.

Nuclear fuels - Visual inspection of burned fuel elements for Angra I and II NPPs; irradiated fuel assembly sipping analysis; specification and design of core components for research reactors; evaluation of fuel performance for power and research reactors and analysis of irradiation damages in metallic materials. A course in fuel visual inspection was also carried out to brazilian fuel supplier personnel - INB.

Safety assessment - Deterministic and probabilistic analyses were conducted using codes and methodologies related to accidents simulation and Probabilistic Safety Assessment (PSA). Specifically, the following activities were conducted: analysis of consequences of accidents in a hexafluoride convertion plant; regulatory review of the PSA for Angra I NPP; and simulation of accidents using RELAP code for Angra II systems. The latter two activities were done in cooperation with the Brazilian nuclear regulatory authority.

Reactor physics Calculations of research reactor cores; criticality analysis of fuel fabrication facilities; and training of people in the application of reactor physics computer code- SCALE. Waste Management A segmented gamma spectrometry system was specified to measure the low activity waste content in operational storages. Scale factors are under investigation and is expected the identification and quantitative evaluation of all isotopes presented in barrels and drums. This activity is yet under development.

Training of operators, plant engineers and accounting inspectors - Training of operational crew of nuclear power plants in radiological protection; reactor operation; nuclear instrumentation and radiation measurements are continuously offered. Training facilities are the nuclear research reactor IPEN/MB- 01 and experimental laboratories. Plant engineers were trained in structural mechanics; codes and normative base of mechanical design; and stress analysis. Courses in the configuration and utilization of instruments for surveillance and accounting of nuclear nuclear material were done.

The specialized services described above were conducted by a team of approximately 18 professionals skilled in engineering and in nuclear technology research. The majority of these professionals work at the Nuclear Engineering Centre (CEN) and also at other departments of IPEN such as the Research Reactor Centre (CRPq), and the Radiological Safety Directorate (DSR). Other department staffs may take part in future projects, since no restrictions are imposed in joining this partnership. A total of approximately 15,000-man-hour was spent in all these activities related to experiments, laboratory and engineering services. The outcome of these technical activities was demonstrated through technical reports, inspections reports and training notes. CEN is equipped with computers and specialized laboratories to accomplish its mission within the state of the art. Computers codes are available as tools for the development of the majority of analyses, among them: RELAP (deterministic analysis in thermal and hydraulics); COBRA (core thermal design); FRAPCOM (fuel design); SCALE (core analysis); PHAST (consequences of explosions and liberations in chemical accidents); RISK SPECTRUM (risk analysis). The customers were some other departments of IPEN, the Brazilian nuclear regulatory authority (named CNEN) and other companies such as the Brazilian nuclear utility (named ELETRONUCLEAR), Brazilian navy technological centre (named CTM-SP) and ABACC- Brazilian - Argentine Agency for Accounting and Control of Nuclear Energy.