STATUS REPORT ON ITALIAN ACTIVITIES

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ENERGY AND THE ENVIRONMENT

1. ENERGY SOURCES AND PRODUCTION IN ITALY IN 1998

1a Primary Energy Supplies

The main features of the Italian energy supply situation in 1998 is shown in Table 1.
Provisional data indicate that Italy's total primary energy demand increased by 2.7% while the total final consumption was mainly attributed to industry, transport and household and services .

1b Electricity Production and Demand

Gross electricity demand (see Table 2) increased during 1998 by 3,4% reflecting the good performance of the Italian economy in the year.
Thermoelectric production increased by 3,4% resulting from a decrease in oil consumption and a sharp increase in natural gas confirming the past years' trend.
Primary electricity signed a similar increase.
Gross electricity reached 260 TWh.

TABLE 1

ITALY – TOTAL PRIMARY ENERGY REQUIREMENT (1) IN 1998(2)

	1998		Change 1998/1997
	Mtoe	%	%
Oil	94.5	52.5	-0.4
Natural gas	51.5	28.6	+7.7
Solid fuels	12.1	6.7	+3.6
Primary electricity (3)	11.3	6.3	+2.4
Net electricity imports	9.0	5.0	+4.5
Renewables	1.7	0.9	+0.1
TOTAL	180.1	100.0	+2.7

(1) Including bunkers
(2) Provisional data
(3) 0.22 kgoe/kWh

1d Liberalization of the electric market

With a legislative decree issued on 16/3/1999 a new law now regulates the electric market in Italy. In such a decree the complex matter of electric energy is treated and the liberalization of energy production, import, export and trade is regulated.
In the coming months many changes have to be realised in order to respect the new electric market discipline.
More precisely ENEL S.p.A. has to create separate societies to perform the following activities:

- electric energy production,
- electric energy distribution and sale to obliged buyers,
- sale to qualified buyers
- assertion of the propriety rights of the transmission grid including the transport lines, the transformer stations and the relative maintenance and development,
- nuclear power plant decommissioning.

As far as the production activity is concerned the law establishes that starting from 01.01.2003 no one can produce or sell, directly or indirectly more than 50% of the total electric energy produced or imported in Italy. To reach this goal, ENEL S.p.A. has to sell at least 15.000 Mw of its capacity by the same date and in the coming months has to present a plan for the plants sale.
The law also regulates the idroelectric franchises and the incentives to renowables sources.
Coming to the nuclear matter the society to be constituted has to assure the old plant decommissioning, the fuel cycle closing and connected activities; this can be obtained also in association with other public bodies that can also become the leader. The Tresaury, Budget and Economical Planning Minister will maintain the shares of the society that has to follow the instructions of the Ministry of Industry.

1e ENEA reform

With a legislative decree issued on January 30th 1999, a new arrangement now regulates ENEA activities devoted both to services for the Ministries and to research in energy and environment fields. Prof. Carlo Rubbia has been recently nominated as new President.

2. NUCLEAR ACTIVITIES

2a Nuclear Fuel Cycle

ENEL continued the activities with regard to the processing and disposal of nuclear waste from phased-out NPPS.
ENEA in the mean time had to proceed to the management of radioactive waste produced in its research centres. Among these, during 1998 has been concluded the treatment compaign of low activity liquid waste that were produced in the Pu plant in Casaccia. In addition in Trisaia, at the ITREC plant, all the low level liquid waste were cemented while the same process will be applied during 1999 to the high level waste.
Activities devoted to finding a national site where low and medium level nuclear waste can be stored, have continued. To develop a conceptual design of the complete system in december 1998 a contract has been signed with the Spanish ENRESA. On the national State

industries. This interest, also shown at governmental level, is confirmed by the 17 billion lire assigned to the two years program TRASCO, about half of which have been given by MURST (the Ministry of the University, Scientific and Technological Research).
TRASCO started in 1998 under the leadership of INFN (National Institute for Nuclear Physics) for the accelerator and of ENEA (National Agency for New Technologies, Energy and Environment) for the sub-critical system. This program is considered of particular relevance for the creation of a well mixed group of competencies and it will provide results of relevant importance in support of any related industrial program.
The program aims to study the physics and to develop the technologies needed to design an Accelerator Driven System for nuclear waste transmutation and was prepared with close reference to Carlo Rubbia's Energy Amplifier proposal.
It consists of two main parts, regarding, respectively, the accelerator and the sub-critical system. Although ENEA and INFN are jointly responsible for the whole program, INFN essentially manages the first part and ENEA the second part.
The project concerns all the main subsystems of an ADS (accelerator, window/target, sub-critical reactor). However, due to the limited available financial resources, efforts are concentrated on some significant and qualified activities, in view of the goal of participation in an international project for the construction of an ADS prototype, like the Energy Amplifier for waste transmutation
The main objectives of the research program can be summarised as follows:

- conceptual design of a 1 GeV - 30 mA proton LINAC;
- design and construction of the proton source and of the first section of the RFQ, as well as of some prototypical cavities concerning the super-conductive LINAC;
- development of methods and criteria for neutronics, thermal-hydraulics and plant design for a sub-critical system, as well as some specific aspects related to the safety analysis of this type of nuclear installation;
- materials technologies and development of components to be used in a plant in which lead or lead-bismuth acts both as a primary target and as a coolant;
- experiments to validate and verify proposed technologies for materials compatibility with lead and lead-bismuth alloys.

The foreseen activities will last two years. Besides ENEA and INFN, also participate in the project some qualified Italian firms and other Italian public research institutions (namely, Universities and INFM, the National Institute for Physics of Matter).
The following nine research sub-programs have been foreseen; each of them is being carried out by a corresponding research group, involving the research institutes and firms reported in brackets.

1. Proton source (INFN, SISTEC, HITEC);
2. Low and medium energy accelerator section (INFN, CINEL);
3. High energy accelerator section (INFN, CISE, SAES-Getters, ZANON);
4. Neutron production for material characterisation (INFN, INFM);
5. General safety criteria and classification (ENEA, ANSALDO)
6. Neutronics and transmutation efficiency (ENEA, CIRTEN, CRS4, University of Bologna);
7. Thermal-hydraulic analysis (ENEA, CIRTEN, CRS4, ANSALDO);
8. Beam window technology (ENEA, CIRTEN, ANSALDO, INFM);
9. Materials technology and compatibility with Lead and/or Lead-Bismuth alloy (ENEA, CIRTEN, CRS4, FN, ANSALDO).

2d2 The Industrial Programme

In parallel to the basic activities above, Ansaldo, a major Italian firm, proposed and started the aforementioned industrial program, with the collaboration of CRS4, ENEA and INFN. This program foresees two main steps:

Table 3: Main Characteristics of the demonstration prototype design.

Power	80 MWth
Accelerator	Three stage cyclotron based on PSI configuration
Target	Pb-Bi eutectic preferably separated from primary coolant
Window	a): window cooled by primary coolant or by separate coolant. b): windowless target (separated, continously renewed free-level target in forced circulation and cooled by primary coolant).
Core	K_{eff}~ 0.95
Fuel	U and Pu MOX. Same geometry of the pellets and comparable isotopic composition of the fuel at the higher enrichment of the second SPX core.
Primary coolant	Pb-Bi (300°C at core inlet, 400 °C at core outlet).
Primary coolant circulation	Circulation enhanced by gas injection in a natural-circulation reactor configuration.
Secondary coolant	Low vapour pressure organic diathermic fluid (280-320 °C)
Normal power removal	Air coolers (system designed to use six air coolers available at ENEA)
In-vessel fuel handling	Two rotating plugs, one fixed arm and one direct lifting machine
Safety-related decay heat removal	Reactor Vessel Air Cooling System (RVACS)
Earthquake protection	Reactor vessel and safety vessel on horizontal anti-seismic supports
Reactor roof	Metallic plate
Main vessel and safety vessel	Hung, 316L steel
Hot shut down temperature	280 °C
Cold shut down temperature	200 °C
Fuel assembly monitoring	Thermocouples and failed fuel pins detection system
Pb-Bi purification	Internal