INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

SecM58-24

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ITALY - SENN'S NUCLEAR POWER STATION

There is attached for information a report received by the Bank on January 27, 1958 from SENN on its choice for a site for its nuclear power station.

Attachment

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Sec. 58-43

REPORT ON THE CHOICE OF THE SITE FOR SENN'S NUCLEAR POWER STATION

1. Introduction

1.1 SENN's nuclear power station is to be built in Southern Italy in compliance with the agreement stipulated between the Italian Government and IBRD.

Thus, the first step consisted in choosing a site which presented the most advantageous features for the construction of the power station, both from the point of view of distance from other generating centers and of the possibility of connection to high voltage transmission lines. Since the largest consuming centers are Rome and Naples, special consideration was given to the zone located between these two cities. Terni Co's large hydro plants, which are complementary in function to a nuclear power plant, gravitate towards that zone; in addition, only short lines will be required for the connection to the national 220-KV grid and thus to SENN's partners', namely, S.R.E., S.M.E. and Terni.

All these conditions would not have been met elsewhere, so it was decided to build the station in the zone between Rome and Naples.

1.2 Although many Italian steam power stations are built along the coast, it was deemed wise to avoid, if possible (1) the corrosive effect of sea water on the condenser circulating equipment, (2) the disturbances caused by the flora and fauna which are particularly rich in our warm seas.

It should be pointed out that the only perennial watercourses in the zone considered, carrying sufficient minimum flow, are the Volturno and the Garigliano Rivers. For this reason, SENN appointed a Committee which was to consider the following sites:

On the Garigliano River:

1 - Punta Fiume, at the mouth

2 - Arco, at 20 km from the mouth

3 - Ponte S. Ambrogio, at the confluence with the Liri River.

On the Volturno River:

4 - Cesarano

On the coast:

5 - Mondragone near Gaeta.

On a brackish lake:

6 - Lago Lungo, on the Sperlonga coast.

1.3 The Committee decided the following sites were to be dropped from consideration:

Cesarano

Competent Authorities had already approved plans under which large amounts of the Volturno waters were to be tapped for irrigation purposes; therefore, the flow available in this river will be insufficient in the future to meet the station requirements. Furthermore, the geological structure of the soil is unfavourable.

Mondragone

This site would require considerable expenditure for the intake off-shore. The solution with cooling towers has proved to be economically unsatisfactory on account of the high plant cost and the high ambient temperature that the water would attain.

Lago Lungo

This site would require considerable expense for the construction of the intake off-shore; besides, the circulating water temperature is, on the average, 7°C higher than the Garigliano water. Finally, the site is too near the Terracina and Sperlonga summer resorts.

This preliminary examination ruled out all but the three sites along the Garigliano, i.e., Punta Fiume, Arco and S. Ambrogio.

1.4 The Committee's report revealed that none of the three sites left displayed individual economic advantages to warrant immediate preference. It was therefore necessary to carry out further studies on the intakes to be built at each site, drill boreholes at S. Ambrogio which had not yet been done, and obtain more details on the characteristics of the radioactive waste disposal in the various types of nuclear power stations.

1.5 The Committee was also of the opinion that proper consideration should be given to the evaluation not only of merely economic factors, but also of the safety and reliability of the discharge works, the possible release of radioactive contaminants after an accident, and finally to the psychological effect on the surrounding population as a result of the construction of a nuclear power station.

2. Report of the A.E.C. and U.K.A.E.A. Consultants

2.1 In October 1957 AEC and UKAEA Consultants were asked to examine and report on the characteristics of the sites at Punta Fiume, S. Ambrogio and Arco from the following standpoints: (1) Accessibility, (2) Water availability, (3) Seismic features, (4) Meteorological conditions, (5) Radioactive waste disposal, (6) Population density, (7) Foundation Problems.

2.2 From the report submitted by the Consultants, no decisive advantage appeared to favour any of the three sites. It did, however, disclose that the choice would have to be restricted to the two sites of S. Ambrogio and Punta Fiume in view of the fact that the Arco site is crossed by a geological fault which offers no reliability with regard to foundation stability.

3. Comparison of the two sites

3.1 In view of the foregoing, SENN has carried out investigative work on the two aforesaid sites, examining them from the same points of view as the Consultants.

a) Accessibility

The transportation of the heavier and more cumbersome components of both the water and gas-graphite reactors to both sites is possible. However, Punta Fiume could use the nearby Gaeta harbour so that the heavier parts could be shipped directly and unloaded on to barges or lorries there.

Moreover, the direct ocean freight or ocean-land road transportation is preferable because, generally speaking, it would be more convenient to avoid the transportation of heavy and bulky parts by rail: the small railway stations near the two sites under consideration do not possess the necessary unloading equipment.

From the point of view of transportation accessibility, Punta Fiume would therefore appear to be more favourable.

b) Water availability

In both the sites, the Garigliano River offers quite a sufficient flow of water for the condenser circulation and for the other plant services. The minimum flow, even after the execution of the planned irrigation canals, will easily meet the requirements even in the event of future enlargement of the power station. The costs of intake and discharge works at the two sites would be substantially

different. Two locations had been proposed at S. Ambrogio, north and south of the access road; in both places these works would cost twice as much as at Punta Fiume.

Thus, Punta Fiume is more advantageous in this respect.

c) Seismic features

Whereas Punta Fiume appears to have a history entirely lacking in recorded seismic disturbances, the zone of S. Ambrogio was touched several times by earthquakes from nearby epicenters. Moreover, since the latter zone is sparsely inhabited, there is no accurate information available on the disturbances, particularly on the magnitude of the accelerations experienced. Since there is no good basis for establishing an acceleration value for which structures would have to be designed, SENN would have to assume responsibility on this point.

Lacking precise data, only conservative values would have to be adopted and this would call for an appreciable increase in the costs of the civil works and foundations. This being so, the Punta Fiume site is definitely to be preferred in this respect.

d) Meteorological conditions

Records on the S. Ambrogio site show that absolutely calm days occur about 30% of the time. This circumstance could prove highly unfavourable if inversion conditions prevail. Since an accurate determination would require long-term statistical observations which cannot be accomplished at this time, it was deemed advisable to consider this situation as unfavourable. On the other hand, all the Tyrrhenian coast presents the known phenomenon of morning and evening breezes which ensure a nearly constant circulation even during summer months. Moreover, in the light of possible accidents, it would seem advisable to take advantage of having the sea over 180° of the horizon with the concomitant 50% probability that a release of radioactive material would be dispersed at sea.

Finally, with regard to the psychological aspect and to the evaluation of a premium for nuclear risk insurance, the construction of the power station on the shore appears to have advantages.

e) Radioactive waste disposal

The presence of numerous irrigation canals tapping water from the Garigliano River leads to some anxiety as to the advisability of discharging radioactive wastes

directly into the river at a point where civilian usage could be affected. There is not enough time to carry out the biological research work suggested by the UKAEA Consultant for an evaluation of ecological factors and effects. Unfortunately, this research work is rendered more difficult by the lack of precise reference data obtained from the operating experience with other similar plants. So, although allowance is made for such a possibility, it is felt that it should be ignored here, because if the aforementioned research work should give negative results, costly works would be required at S. Ambrogio for hold-up capacity and for transporting wastes to the sea. Conversely, the installation of the power station at Punta Fiume would eliminate any doubt on this delicate side of the question because the discharges, after hold-up, would be made almost directly into the sea.

f) Population density

In this respect, there is little to choose between the two sites.

g) Foundations

The exploratory work conducted at both S. Ambrogio and Punta Fiume revealed that the soil conditions do not differ greatly, and that therefore at this stage of our knowledge there are no advantages in one site over the other.

Generally speaking, considerations of the foundation problem, although important, cannot be a determining factor in a choice between the two sites, owing to the similarity in the soil conditions.

A separate report (Appendix A of the Invitation to Bid) describes the investigation performed and the conclusions reached. It can be said here that at Punta Fiume no foundation difficulty is anticipated for any kind of reactor, except possibly for a higher cost in the case of those plants which entail a heavier load per unit surface. However, our Civil Engineers have estimated that the difference in cost between the most extreme cases, represented by the different designs, will be of the order of 1 to 1.5% of the plant cost. This is neither high enough to determine the choice nor to affect the relative bid evaluation.

In this connection, it must be added that some manufacturers of the heavier-load designs have stated that they are in a position to reduce the specific load to figures of the order of 1.8 kg/sq cm (comparable to the lighter-

load designs) without appreciable variations in the cost of equipment or in the plant efficiency.

4. Conclusion

In view of the foregoing, SENN feel that the Punta Fiume site is the most suitable for the installation of their first nuclear power station.