

not say about the Enola Gay, the aircraft used to bomb Hiroshima, which they had restored and planned to exhibit. Veterans insisted the only possible view was that dropping the bombs significantly shortened the war. The museum's curators had to scrap their planned exhibit which had offered a range of perspectives on these events.⁴⁵

Nuclear energy: from moonshine to evil or good?

This sequence of exhibitions encapsulates a very dramatic and human history. It starts with *Atom Tracks* which portrayed nuclear physics as pure science, scientific research with no expectation of practical outcome. Such expectations were "moonshine".

A decade later, *Atom Train* offered a radically different perspective. It dealt with the world-changing events of the dropping of the atomic bombs. Several of atomic scientists who had participated in the Bomb projects helped make the exhibition, including Joseph Rotblat, who was awarded the Nobel Peace Prize many decades later.

Atom Train provided an opportunity for the members of the ASA to interact with a broader public. The exhibition illustrated recent nuclear developments and outlined the need for international control of nuclear weapons and the possible benefits of nuclear power. In turn, they hoped the public would agree and support these policies. Members of the

ASA had their own personal and professional reasons for advancing ideas about the "good" of nuclear power offsetting the "evil" of weapons – to reduce their feelings of guilt and to blunt possible criticism from the public. But this idea of the benefit-of-nuclear power offsetting bad weapons, I have argued, had a legacy shaping public attitudes to nuclear power. It's a powerful human urge to make good come from evil: swords can be beaten into ploughshares.⁴⁶

Governments then took up the idea of nuclear-power-as-benefit. Now the benefits of nuclear power were not to compensate for the development of nuclear weapons, but rather an over-optimistic assessment of the benefits of nuclear power became a screen for the development of even more destructive nuclear weapons.

By the time of the Nuclear Physics and Nuclear Power exhibition in 1982, the nuclear industry, marshalled by the UKAEA, planned a new generation of nuclear power plants in the UK. But they did not control events and their plans were dashed. A new, cheap and efficient technology for using natural gas to generate electricity, the Combined Cycle Gas Turbine, coupled with plentiful and cheap supplies of gas from beneath the North Sea (the so-called "Dash for Gas"), meant nuclear power stations were uncompetitive from the early 1990s.⁴⁷ Only one PWR was built and the UK nuclear industry abandoned its plans for expansion.

⁴⁵ See Martin Harwit, *An Exhibit Denied: Lobbying the History of the Enola Gay*, New York: Copernicus 1996.

⁴⁶ That theme was developed further with a temporary exhibition curated by Jost Lemmerich in Berlin, *Science and Conscience: the work of Max Born and James Franck*.

⁴⁷ The first CCGT in the UK was built at Teesside by Enron.

BRITISH FIRST NUCLEAR EXPORT: ENI'S ATOMIC POWER STATION at Latina and Anglo-Italian nuclear cooperation

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Résumé

Cette étude enquête sur l'histoire de la première centrale nucléaire britannique vendue à l'étranger. Une analyse de la situation intérieure complexe de l'Italie, caractérisée par un grand tournant potentiel dans l'équilibre des pouvoirs politiques et économiques, étudie les raisons qui ont permis au Royaume-Uni d'exporter une centrale entière clés en main, à une époque de concurrence virulente avec les États-Unis dans le domaine de la technologie nucléaire pacifique. Cette analyse démontre comment les Britanniques étaient prêts à coopérer avec leurs homologues italiens, partageant au moins en partie leur savoir faire, clé du succès leur permettant de remporter l'intérêt de l'ENI. Elle explique également comment le projet anglo-italien de Latina peut être considéré comme un succès, bien que l'Italie n'ait plus été un débouché important pour l'exportation du nucléaire britannique.

Abstract

This study investigates the story of the first British nuclear power station sold abroad. Analysing the complex Italian domestic situation, characterised by a potential watershed in the political and economic balance of power, it looks at the reasons that allowed U.K. first export of a complete power station at the time of a virulent competition with the United States in peaceful nuclear technology. It shows that British availability to cooperate with the Italian counterparts, at least partially sharing the know-how, was the key for success in winning ENI interest. It further explains how the Anglo-Italian enterprise at Latina can be considered as successful, although Italy did not later represent an important outlet for British nuclear export.

The late 1950s were an extraordinary moment in many respects for nuclear power industry. Before a sudden change in energy trends in favour of fossil fuels and a corresponding consolidation of nuclear power projects by the end of the decade, the first Geneva Conference epitomised a period marked by a widespread optimism on the near-immediate prospects for nuclear energy industrial applications¹. Britain offers a very good example of such a course with the first White Paper on the installation of nuclear power generating capacities in 1955² – thus well in advance of the Suez crisis – which was first trebled in 1957³ and then consolidated in 1960⁴. Moreover, the same years saw the founda-

tion of regional and global organisations devoted to the peaceful applications of the atom, such as the European Nuclear Energy Agency⁵, Euratom⁶ and the IAEA⁷, so establishing a multi-layered framework for international cooperation.

Beneath the stress posed on cooperation, the same period was characterised by two sets of tensions. On the one hand, the competition between 'European' and American reactor technologies, the so-called *guerre des filières* between natural uranium-fuelled, plutonium producing systems and the US "water reactors" using slightly enriched uranium⁸. On the other hand, in Italy, nuclear power was not merely the new frontier of energy generation for a growing industrial country, rather

it was instrumental in the conflict for the nationalisation of electricity, which in turn was supposed to represent the occasion for emergence of a new economic and political balance of power⁹.

ENI goes nuclear

Against this background, the industrial action of Ente Nazionale Idrocarburi (ENI) – a state-owned oil, gas and chemical concern led by Enrico Mattei¹⁰ – should have focused on nuclear fuel beginning with a nation-wide search for uranium ore¹¹. But Mattei had an interest that ENI was an active subject in nuclear power generation, maybe succeeding in building the very first Italian station. Such a course was conducive in rising the chances for ENI to become the sole energy champion in Italy. Indeed, strengthening ENI's foothold in electricity generation by a strong presence in nuclear power, in competition both with private utilities and the other big state-owned industrial concern, Istituto per la Ricostruzione Industriale (IRI, a public holding active especially in mechanical engineering), was supposed to help Mattei and his powerful political

acquaintances to impose a solution to the nationalisation issue that would have put under ENI – so under public control – every sort of energy supply¹².

It seems, however, that Mattei considered nuclear power as a medium-term prospect rather than an immediate option. Accordingly attention should focus on the establishment of a suitable industrial infrastructure in Italy in order to enable the country to participate to the future exploitation of the atom.

« It is not foreseen a rapid, large-scale exploitation of nuclear energy for industrial purposes due to still unresolved scientific, technical and economic problems. In this area, Italy suffers a considerable delay compared to other European countries. [...] It does not seem appropriate, however, that future nuclear power production should be obtained only by means of plants and materials of foreign origin. It is thus urgent for our country to develop all activities concerned with nuclear energy exploitation: from research and machining of radioactive ores to production of special materials, construction of reprocessing plants and training of personnel¹³. »

1. The Geneva Conference, with some 1400 delegates from 73 different countries, represented the first far-reaching exchange of know-how and data beyond standard Cold War divisions. It propelled the idea that reactor technology was already developed enough to allow rather optimistic estimates concerning the short- and medium-term prospect for nuclear power generation compared to fossil fuels. See *International Conference on the Peaceful Uses of Atomic Energy. Geneva, 8-20 August, 1955. Programme*, New York, United Nations Department of Public Information, 1955 and James Pickard (ed.), *Nuclear Power Reactors*, London, Van Nostrand, 1957.

2. Ministry of Power and Fuel, *A Programme of Nuclear Power*, Cmd. 9389, London, H.M.S.O., 1955.

3. Ministry of Power and Fuel, Scottish Office, *Capital Investment in the Coal, Gas and Electricity Industries*, London, H.M.S.O., 1957.

4. Rowland Pocock, *Nuclear Power: Its Development in the United Kingdom*, Old Woking, Unwin Brothers Ltd., 1977, pp. 30-36, 45-59; Roger Williams, *The Nuclear Power Decisions: British Policies 1953-79*, London, Croom Helm, 1980, pp. 34-61.

5. Mauro Elli, "La cooperazione nucleare in Europa. Il caso dell'ENEA", in Alfredo Canavero, Guido Formigoni, Giorgio Vecchio (eds.), *Le sfide della pace*, Milano, LED, 2008, pp. 111-127. On ENEA joint projects see E.N. Shaw, *Europe's Nuclear Power Experiment. History of the OECD Dragon Project*, Oxford, Pergamon Press, 1983; Jean-Marc Wolff, *Eurochemie 1956-1990, Thirty-five Years of International Co-operation in the Field of Nuclear Engineering*, Paris, NEA, 1996. M. Elli, "European Cooperation and Technological Innovation. Applied Research in the OEEC Halden Reactor Project", in Christophe Bouneau, David Burigana, Antonio Versori (eds.), *Trends in Technological Innovation and the European Construction*, Brussels, Lang, 2010, pp. 141-154.

6. Jaroslav Polach, EURATOM. *Its Background, Issues and Economic Implications*, New York, Oceana Publications, 1964. Laurence Scheinman, *L'intégration nucléaire en Europe: l'Euratom*, Lausanne, Imprimerie Vandoise, 1968. Olivier Pirotte et al., *Trente ans d'expérience EURATOM*, Bruxelles, Bruylant, 1988. See (1991), pp. 387-410. Mauro Elli, "The United States and the Formation of EURATOM", *Diplomatic History*, vol. 15 no. 3 (1957-1963), Milano, Unicopli, 2007. European Commission, *Euratom: 50 Years of Nuclear Energy Serving Europe*, Luxembourg, Office for Official Publications of the European Communities, 2007.

7. See David Fischer, *History of the International Atomic Energy Agency: The First Forty Years*, Vienna, IAEA, 1997. Russell Howell, *The International Atomic Energy Agency*, New York, Chelsea House, 2009.

8. Both the U.K. and France developed basically the same reactor technology based on natural uranium fuel. See Bertrand Goldschmidt, *Les rivalités atomiques*, Italian translation *Le rivalità atomiche*, Milano, Saggiatore, 1968, pp. 281-290.

9. See especially Barbara Curli, *Il progetto nucleare italiano (1952-1964). Conversazioni con Felice Ippolito*, Soveria Mennelli, Rubbettino, 2000, pp. 20-35. With a different nuance works by Giovanni Paoloni, "Gli esordi del nucleare", in Valerio Castronovo (ed.), *Storia dell'industria elettrica in Italia, vol. 4: Dal dopoguerra alla nazionalizzazione, 1945-1962*, Roma-Bari, Laterza, 1994, pp. 383-408. Id., "Dal CNRN al CNEN 1952-1960", *Energia, ambiente, innovazione: dal CNRN all'ENEA*, Roma-Bari, Laterza, 1994, pp. 5-43.

10. Among many different works on Mattei and ENI's oil activities see Giorgio Galli, *La sfida perduta: biografia politica di Enrico Mattei*, Milano, Bompiani, 1976; Giulio Sapelli, Francesca Carnevali, *Uno sviluppo tra politica e strategia: ENI 1953-1985*, Milano, Angeli, 1992. Leonardo Maugeri, *L'arma del petrolio: questione petrolifera globale, guerra fredda e politica italiana nella vicenda di Enrico Mattei*, Firenze, Loggia de' Lanzi, 1994; Nico Perrone, *Enrico Mattei*, Bologna, Il Mulino, 2001; Daniele Pozzi, *Dai gatti selvaggi al cane a sei zampe: tecnologia, conoscenza e organizzazione nell'AGIP e nell'ENI di Enrico Mattei*, Venezia, Marsilio, 2009.

11. In 1955 ENI established an ad-hoc society to search and exploit uranium ore in Italy called SOMIREN (Società Minerali Radioattivi Energia Nucleare). ENI Archives (henceforth ASENI), material waiting stock-taking, *verbale della seduta del Consiglio dell'ENI del 28 giugno 1955*, n.d.

12. Enrico Crispino, "Energia e ricerca", *Annali dell'economia italiana*, vol. 12, no. 2, p. 435. Marcello Colitti, *Energia e sviluppo in Italia: la vicenda di Enrico Mattei*, Bari, De Donato, 1979, pp. 213-220.

13. My translation. ASENI, material waiting stock-taking, *verbale della seduta del Consiglio dell'ENI del 30 giugno 1956*, n.d.

Also the Italian government of the time was on the one hand apparently concerned that Italy was lagging behind in nuclear technology; on the other hand, it was committed to a policy of massive investments with a view to generating economic (especially industrial) growth in the underdeveloped southern part of the country, the so-called Mezzogiorno. In this latter respect, on 11 October 1956, the government gave Mattei a mandate to build a nuclear power station in southern Italy together with IRI and another one in the North in partnership with a private industrial subject¹⁴.

The choice of a site for the southern power station eventually fell on the Latina countryside on the sea, so roughly half a way between two big electric consumption centres like Rome and Naples. The northern plant did not materialise – at least not in the way the Italian government had suggested. Indeed, besides the Latina project, by the end of 1950s there were other two nuclear power stations under construction in Italy. IRI began building a plant on the River Garigliano, not far from Naples, powered with a General Electric boiling water reactor and financed by the World Bank. The reactor choice was made after a long and scathing tender competition ending with the two main competitors – the United States and Britain – substantially on a technical par. It is most likely that IRI went American because Mattei had previously

chosen a British reactor for his project and because Ansaldo (one of IRI's subsidiaries) was already a General Electric licensee for conventional thermal stations¹⁵. In the north, Edison – the single biggest private utility – was building in Piedmont another power station with a Westinghouse pressurised water reactor. First contacts between Edison and Westinghouse dated back to 1954 and the Italian utility stepped up its effort just after Geneva, with the idea of countering the increasing pressure in favour of electricity nationalisation by a big exploit in nuclear power. Difficulties of siting and the relative immaturity of the technology concerned made Edison's power station the last going critical¹⁶.

British interests for Italy

With three nuclear power stations of different design ordered by competing industrial subjects, Italy was probably the most important single proving ground in the Anglo-American technological and commercial competition, so it is not surprising to assist to a concerted effort on the part of the British government and foreign service (namely the embassy in Rome and the consulate in Milan), the United Kingdom Atomic Energy Authority (UKAEA) and the nuclear consortia to promote exports. In London there was a remarkably clear view of the evolving Italian nuclear environment. A good example is the remark by Foreign

Office deputy permanent undersecretary Alexander Stirling regarding SENN (Società Elettro-nucleare Nazionale) choice of an American reactor for the Garigliano project.

« Nobody who has had dealings with SENN project has apparently any doubt but that the US firm will get the contract, partly because of unscrupulous American pressure, but mainly because the Agip Nucleare [ENI's nuclear branch] nuclear power station contract is virtually committed to a UK firm. The Authority are angry that a technical decision should be going against them on political ground, but, unofficially at any rate, they are not taking it too tragically. Their Industrial Group had remarked that although this will at first be a blow to our export prospects, the picture may well be difficult in a year's time when the Italians can compare progress on the UK and US reactors – the Authority have the utmost confidence in their own type¹⁷. »

This awareness was due to a great deal of information accruing from a number of qualified sources. The legal counsel of the embassy in Rome, Guy Hannaford, had access to Mattei and ENI top management¹⁸, as well as he was privy to the political and bureaucratic machine. This role would be most useful during the frantic efforts to ratify the Anglo-Italian bilateral agreement on the peaceful applications of atomic energy before the dissolution of the Italian Parliament.

The solution found in March 1958 with Hannaford's prodding was constitutionally dubious and heavily reliant on the goodwill of the President of the Republic, Giovanni Gronchi, who had close relations with Mattei¹⁹. Walter Hacon, the commercial consul in Milan, had important contacts in the electric industry. He timely warned Whitehall that initiative was passing from private to public sector in Italy, stressing in particular the aggressive nuclear project nurtured by ENI²⁰, and served as reference for people who favoured British technology in private utilities, such as Mario Bruni, technical director of La Centrale and open supporter of natural uranium reactors²¹, their counterparts in electricity-generating concerns, like Claudio Castellani, director of Montecatini's energy branch, and people in industrial entities devoted to applied nuclear research, like Luciano Orsoni, technical director of SORIN (Società Ricerche Impianti Nucleari)²².

On their part, The Nuclear Power Plant Company (NPPC, a consortium including Parsons, Reyrolle, Chapman, Head Wrightson, Strachan & Henshaw, Whessoe, Sir Robert McAlpine and Finlay) and the UKAEA made a promotional and advertising effort in concert with ENI in a couple of occasions, but the British were absolutely sure that they could not profitably compete with the United States in this sort of activity: rather it was considered much more

14. ASENI, H.III.4-73-5A4: *verbale della riunione del Comitato dei ministri del 11 ottobre 1956*, n.d.; Ferrari *Aggradi to Mattei*, 27 Oct. 1956.

15. Barbara Curli, "Energia nucleare per il Mezzogiorno. L'Italia e la Banca Mondiale (1955-1959)", *Studi Storici*, anno 37, n. 1, 1996, pp. 317-351. Anna Rosa Rigano, "La Banca d'Italia e il Progetto ENSI. Fonti per la storia dello sviluppo energetico italiano degli anni Cinquanta nelle carte dell'Archivio della Banca d'Italia", *Quaderni dell'Ufficio Ricerche Storiche della Banca d'Italia*, n. 4, giugno 2003.

16. Mario Silvestri, *Il costo della menzogna. Italia nucleare 1945-1968*, Torino, Einaudi, 1968, pp. 103-104. Luigi De Paoli, "Programmi d'investimento e novità tecniche", in Valerio Castronovo, *Storia dell'industria elettrica in Italia*, vol. 4, cit., pp. 215-216, 223-226.

17. United Kingdom National Archives (henceforth UKNA), FO 371/135583: *hand-written minute by Stirling*, 19 Aug. 1958.

18. UKNA, FO 371/129289: *Unwin to Hooper*, 12 Apr. 1957.

19. UKNA, FO 371/135581: *minutes by Hannaford*, 12, 15 and 17 Mar. 1958.

20. UKNA, FO 371/129289: *memorandum by Hacon*, 27 Feb. 1957; *Hacon to Unwin*, 13 Apr. 1957.

21. See Mario Bruni, "Possibilità tecnico-economiche di alcuni tipi di centrali elettro-nucleari", *Energia nucleare*, anno IV, n. 3 supplement, Jun. 1957, pp. 112-124. Bruni had specifically dealt with Calder Hall in *Aspetti industriali della produzione di energia elettro-nucleare: la centrale di Calder Hall*, *L'Elettrotecnica*, n. 7, 1956.

22. UKNA, FO 371/129289: *Hacon to Hood*, 11 Jan. 1957; *memorandum by Hacon*, 27 Feb. 1957; *Hacon to Hood*, 1 Mar. 1957.

effective a measure for the eventual success of British technology working hard on the Latina project with a view to making it the first operating nuclear power station in Italy²³. All in all, attacks by British technical press regarding a supposed lack of vigour in export efforts seem inadequate²⁴. They apparently did not take into proper account the actual limits of any British action aimed at influencing the choice of reactor, with respect to both the complex Italian domestic situation and the strength of American commercial efforts²⁵.

The reasons of Mattei's choice

The question now is: why Mattei went British for Latina? Actually at the time there occurred an acrimonious controversy in Italian press accusing Mattei of squandering public money by choosing the British in order to give the Americans a tit for tat for oil reasons²⁶. These attacks, as well as the accusation of early obsolescence of the British type of reactor²⁷ when there was still no proven comparative experience of UK and American technologies under so-called 'normal' industrial conditions, were simply groundless. Their reason lays in the deep hostility of the private sector

against Mattei in particular and more generally against any move in the direction of electricity nationalisation together with a change in the domestic political balance. Still, it is true that for Latina it was initially envisaged a US-designed station, which was indeed subject of a study conducted by the Vitro Corporation of America²⁸. So why did Mattei change course?

When ENI created its nuclear branch – Agip Nucleare – this was envisaged as instrumental to the foundation of a sound, full-fledged nuclear industry in Italy. It meant that Agip Nucleare was structured as a big engineering organisation that, along with the ENI branch devoted to the cultivation of fissile materials, should have provided services along the whole nuclear cycle. As it was noted at the time, the structure of Agip Nucleare seemed to duplicate the functions of the Italian public nuclear authority and to coalesce them with those of a private engineering company²⁹. Such a big organisation, which actually predated on the very few available manpower in the country, was put under the direction of Gino Martinoli. At the time Martinoli was probably one of the best managers available, with an outstanding background in industrial organisation and a deep knowledge in

management techniques³⁰. By the way, he himself was a 'prize' of Mattei's first recruitment campaign³¹.

In a first effort Martinoli put up a programming office³², which prepared a plan for the creation of nuclear industry in Italy. Publicly presented in June 1957, the plan envisaged that by 1965 four pressurized water reactors and six gas-cooled reactors (amounting to some 2000MW) would entered into service; other plants would follow to reach a total installed power of 12.000 MW by 1975. According to the plan the single biggest problem of such a course would be the exacting demand of highly qualified manpower: 1350 engineers, 435 physicists, 360 chemists, 7500 technicians and 15.000 operators by 1966³³. This ambitious – and overstretched – approach was soon discarded in 1959, when prospects for nuclear power generation had changed in Italy and the world, and Martinoli left office. With its top manager out and the position of chief executive officer abolished in Agip Nucleare statutes, ENI nuclear branch became much more dependent – if not subservient – from interests and directives of the holding company³⁴.

In any case it is important to note that at the beginning Latina was not envisaged as a white elephant. On the contrary, buying

a nuclear power station abroad was considered a necessary toll to pay in order to acquire a first core of know-how through technical cooperation and the formation of personnel. There was no interest at all for a turn-key contract. The British option was chosen because it was more conducive with respect to these purposes, and their industrial organisation seemed more integrated. As the records of the Agip Nucleare board meeting of 25 July 1957 put it:

« This is a most committing choice. Indeed, besides technical and cost considerations, our choice is oriented to favouring the group that is disposed to cooperate with us, viz. by agreeing the establishment of a mixed Anglo-Italian organisation for the successful completion of the project here in Italy. [...] We would like to have a certain number of English executives and supervisors, but we would like to provide all subordinated technical and administrative personnel; hence the latter would be able to acquire from the English staff know-how and specific experiences. At project's conclusion the Italian staff should be able to replace the English one in almost every area³⁵. »

First, the British had comparably more operating experience than the American in commercial size plants; second, thanks even to the good auspices of the diplo-

23. Ukna, FO 371/135582: *Hannaford to Stirling*, 13 Jun. 1958. UKNA, FO 371/135583: *Christofas to Stirling*, 14 Aug. 1958. Ukna, FO 371/140637: *Clarke to FO*, tel. n. 357, 30 May 1959; *FO to Rome*, tel. n. 550, 4 Jun. 1959.
24. For example "Export Effort Inadequate", *Nuclear Engineering*, vol. III, n. 25, Apr. 1958, pp. 137-139.
25. Ukna, FO 371/129291: *minute by Unwin*, 7 ottobre 1957.
26. "Golia contribuente", *Il Tempo*, n. 170, 20 giugno 1959. "Spesa atomica", *ivi*, n. 173, 23 giugno 1959. Riccardo Sennato, "Atomi e miliardi", *ivi*, n. 182, 2 luglio 1959. "Atomi parastatali", *ivi*, n. 184, 4 luglio 1959. Edgardo Beltrametti, "Biscotti atomici", *Il Borghese*, reprint in *Stampa e oro nero. Documentario della campagna di stampa contro l'ENI*, vol. 25: 1959, Roma, Istituto Grafico Tiberino, 1960, pp. 339-341.
27. Marco Tedeschi, "L'Agip Nucleare disintegrerà i nostri risparmi", *La Notte*, n. 275, 20 novembre 1957. Edgardo Beltrametti, "L'ENI ha scelto i ferrivecchi inglesi", *Il Borghese*, n. 25, 21 giugno 1957, reprint in *Stampa e oro nero. Documentario della campagna di stampa contro l'ENI*, vol. 15: 1957, Roma, Istituto Grafico Tiberino, 1959, pp. 348-351.
28. Aseni., R.III.5-57-3965: *verbale dell'assemblea ordinaria e straordinaria della Simea del 9 maggio 1958*, n.d. Ukna, FO 371/129291: *Rome to FO*, 27 Jul. 1957; *Clarke to FO*, tel. n. 459, 1 Aug. 1957. "Conclusa la trattativa con la Vitro", *Energia nucleare*, vol. IV (1957), n. 5, p. 434.
29. Silvestri, *Il costo della menzogna*, cit., pp. 196-198.

30. Fabio Lavista, *Cultura manageriale e industria italiana: Gino Martinoli fra organizzazione d'impresa e politiche di sviluppo, 1945-1970*, Milano, Guerini, 2005.

31. Carlo De Amicis, Mirella Fulvi, *Conversando con Gino Martinoli*, Roma, Fondazione Olivetti, 1991, pp. 83-84.

32. Aseni., BE.III.2-24-7A: *verbale del consiglio d'amministrazione dell'Agip Nucleare del 28 dicembre 1956*, n.d.

33. Aseni., material waiting stock-taking: *verbale della seduta del Consiglio dell'ENI del 27 giugno 1958*, n.d. UKNA, AB 16/2170: *summary of a lecture given by Martinoli at the Second Technical Conference on Nuclear Energy in Rome*, s.d.; Agip Nucleare, *proposals for an Italian electronuclear programme*, 12 Jul. 1957.

34. Aseni., BE.III.2-24-7A: *verbale del consiglio d'amministrazione di Agip Nucleare del 27 gennaio 1959*, n.d. Aseni., AD.I.3-24-32EF: *ordine di servizio n. 26*, 27 Jan. 1959. Aseni., D.I.3-19-20E9: *verbale del consiglio d'amministrazione della SIMEA del 19 febbraio 1959*, n.d..

35. My translation. ASENI, BE.III.2-24-7A: *verbale del consiglio d'amministrazione di Agip Nucleare del 25 luglio 1957*, n.d..

matic personnel and the consultancy of the UKAEA³⁶, the British option seemed readier to go; third, the nuclear consortia appeared more willing to cooperate in the transfer of know-how and in the creation of a genuine industrial partnership with Agip Nucleare. Accordingly, among the consortia, it was chosen The Nuclear Power Plant Company – though the General Electric Company of England had placed its bid first and the Associated Electrical Industries was considered financially sounder – because it was disposed not simply to guarantee the performance and output of the plant, but also to sign a cooperation agreement with Agip Nucleare³⁷. By way of technical cooperation beginning with the Latina project and the training of personnel, the Italian side would progressively acquire sufficient command of the know-how to bid autonomously in the nuclear market – thanks to an exclusive licence for Italy which NPPC would grant to Agip Nucleare³⁸.

Anglo-Italian partnership

Mattei signed a letter of intent on 15 November 1957. This made a clear distinction between the cooperation

agreement and the commercial contracts covering the plant, which were to be finalised later on³⁹. The British ambassador to Rome, Ashley Clark, congratulated Mattei for the choice:

« I am particularly happy that the first agreement of this kind in the world has been finalised by Italian and British organisations. I dare hope I am allowed to address my greatest praise to your personal initiative and far-sightedness, which have made possible this promising Anglo-Italian enterprise⁴⁰. »

The cooperation agreement between Agip Nucleare and NPPC was signed in London on 2 May 1958. British press gave considerable attention to the news⁴¹ on a document envisaging the granting to Agip Nucleare of an exclusive licence for Italy (non-exclusive for the rest of the world) and the creation of a joint agency for the commercialisation of the Magnox reactor, along with measures for training the Italian staff, transferring the relevant know-how and cooperating in applied research⁴². Together with this agreement, there was the consultancy contract with the UKAEA and the prospect of supplying nuclear fuel to Latina. According to the custom of the time,

Mattei (right) shakes hands with Claude Gibb, NPPC chairman, on 2 May 1958 (ENI Archive).



everything was further covered under a bilateral agreement between Italy and the UK providing the latter with the right of ensuring that the nuclear material concerned were used exclusively for peaceful purposes⁴³.

One should point out that the two sides showed different sensibilities regarding the cooperation agreement. For NPPC it was above all a matter of cashing in its know-how and, at the same time, keeping the Italian customer tied to British technology. The CEO of NPPC, Arthur Sayers, wrote to the Ukaea Industrial Group in the following terms:

« I hope you will agree we have done a good stroke of business in arranging that you will get a royalty on all power stations supplied in association with Agip Nucleare for at least 7 years. We hope we can scoop the pool and keep the Americans, the French, and the other people out. In no other way do we think

control could be assured so that something will continue to come back to this country⁴⁴. »

Actually the Authority was not completely satisfied, at least with the way negotiations took place. As the owner of the Calder Hall technology, it was very keen on a return in the form of royalties. Considering that the licence agreement between the Authority and the consortia concerning Calder Hall technology would not be signed until February 1959⁴⁵, the former wished to act as an *eminence grise* behind NPPC to make sure that its interests were safeguarded, hence it was particularly frustrated when the consortium refused being patronised and completed the last stage of negotiations on its own. As the UKAEA Industrial Group commercial manager put it:

« [...] it appeared that NPPC had been irresponsible in not discussing with us the drafting of this agreement over the last six months, and that they could expect no official views from us at a few hours' notice. Sayers accepted this and apologized for the short notice, but I am myself convinced that NPPC are purposely playing their cards in this way so as to make it politically difficult for us not to approve the agreement after it is signed next Friday with the usual trumpet blowing⁴⁶. »

Instead, Mattei emphasized to the executive board of ENI the importance of the agreement for the training of personnel, with a view to establishing in due time independent design resources inside the Italian industrial group. With

36. The UKAEA would help Agip Nucleare in the evaluation of nuclear and safety details of the British tenders received and would, a bit reluctantly, serve as tantamount of a consulting engineer. UKNA, AB 16/2170: Johnson to Martinoli, 22 Jul. 1957; provision of advisory services by the UKAEA, 1 Aug. 1957; Mattei to Plowden, 30 Jul. 1957.

37. UKNA, AB 16/2170: relations with Italy, 3 Jun. 1957; minute by Strath to Pierson, 25 Jun. 1957; Johnson to Pierson, 4 Jul. 1957; Rome to FO, tel. n. 5357, 16 Jul. 1957. UKNA, FO 371/129290: Clarke to Maude, 14 Jun. 1957. Italian State Central Archive (henceforth ACS), Fondo SIMEA, busta 471, cartella 1703: proposed basis for agreement between AN and NPPC, 15 Jul. 1957.

38. UKNA, FO 351/129291: Rome to FO, 7 Sep. 1957; Rome to BoT, tel. n. 68, 19 Oct. 1957. UKNA, AB 16/2170: Martinoli to Johnson, 16 Nov. 1957. ASENI, BE.III.2-24-7A: verbale del consiglio d'amministrazione di Agip Nucleare del 28 novembre 1957, n.d.

39. ASENI, H.III.4-78-5F5: Mattei to NPPC, 15 Nov. 1957.

40. My translation. ASENI, H.III.4-78-5F5: Clarke to Mattei, 21 Nov. 1957.

41. See for example "Nuclear Power Plant Talks with Italy", *Financial Times*, 2 May 1958; "UK-Italian Atom Pact", *ivi*, 3 May 1958.

42. UKNA, AB 16/2054: discussion with Sayers at Knutsford on 1 January 1958, n.d.; Gibb to Plowden, 24 Apr. 1958; NPPC-AN Technical Cooperation Agreement, 23 Apr. 1958.

43. Agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the Italian Republic for Co-operation in the Peaceful Uses of Atomic Energy, Rome, December 28, 1957, London, HMSO, 1958.

44. UKNA, AB 16/2054: Sayers to IG, 4 Dec. 1957.

45. UKNA, AB 16/2054: Oliver to Highton, 6 Feb. 1959; Highton to Oliver, 11 Feb. 1959.

46. UKNA, AB 16/2054: Warren to Drake, 25 Apr. 1958.

such a purpose in mind, it was envisaged a common research and development programme jointly pursued in the laboratories of NPPC and ENI – respectively at Knutsford and San Donato Milanese⁴⁷.

The situation changed drastically in 1959. Italian aims switched from a massive, long-term programme to the successful completion of Latina and the best employment of the resources already developed. Without ambitious targets, several highly skilled elements of the staff started a diaspora towards other organizations concerned with nuclear energy, both in Italy and at the European Atomic Energy Community⁴⁸. On the one hand, this consolidation was in line with the global retrenchment of nuclear industry.

Also in Italy, as in the other industrialised countries, the lessening of tension in the sector of energy sources has allowed more detached a consideration of the developmental perspectives of nuclear power production, so leading efforts to focus on the fields of research, testing and training – without surrendering the achievement of the first full-sized power stations⁴⁹.

By 1961 ENI would look for help from the Italian government on the base of the public interest connected with its existing nuclear capabilities.

« An area where the cleavage between the strict business interest and the general national interest is typically manifest is undoubtedly nuclear energy. Indeed, nowadays the main purpose of investments, efforts and realizations in this area is approaching the time when the

national economy will be able to make use of the new energy source in order to produce electricity at competitive costs with conventional sources. [...] The basic economic needs, which nuclear industry must help to meet, the size and difficulty of the challenges the latter poses on both scientific and applied levels, the awesomeness of costs and investments that both levels require, the very sensitiveness involved in the responsibility of operating in the nuclear field do not leave doubts that the development of nuclear energy applications represents a function of eminent public interest, which the State must – directly or indirectly – support in a way consistent with the entity of the stake⁵⁰. »

On the other hand consolidation was the result of domestic dynamics in Italy, where Mattei's bid on energy had been defeated in the context of the controversy on the nationalisation of electricity. According to Malcolm Gale, in the commercial section of the consulate in Milan, the fall of the government led by Amintore Fanfani on 26 January 1959 forced Mattei to cover his back. Now his political enemies would not spare broadsides accusing him of squandering public money for a very expensive and rapidly obsolescent plant just in order to grandstand his bid. Most of all, the idea of enlarging the government area by a political alliance with the Socialist Party – a course supported by both Mattei and the left wing of the ruling Christian Democratic Party – had to be shelved for the while. It is interesting to note that Mattei

informed the board of Agip Nucleare of Martinoli's removal as CEO right the day after Fanfani's downfall⁵¹.

Accordingly, ENI's actions responded to a new set of priorities: first, assuring that the Latina station would produce power at 7,5 liras per KWh as originally envisaged; second, extracting from NPPC – and then from the Authority – any possible advantage and any piece of know-how at the least price possible. This was accomplished – at least as far as NPPC was concerned – by blackmail, namely by refusing to sign the contract covering the Latina plant while the British consortium was getting financially more and more embroiled on the construction site. The contract was signed only on 29 January 1960, after NPPC had cut more than 2 million pounds on the price and conceded wider guarantees⁵².

An in-depth study of these troublesome negotiations – as well as of the even more complicated ones with the UKAEA on the fuel supply – goes beyond the limits of the present investigation. Here one should cursorily note, however, that even British internal papers show a peculiar difficulty in producing cost forecasts that were something more than mere figure-guessing. It seems that eventually the British were not on the red tape in

any case, but this apparently objective difficulty – together with a tendency on the part of the UKAEA and NPPC to pass the buck each other in order to sort out their own difficulties – did not contribute positively to the global competitiveness of UK nuclear industry.

Training of personnel and joint research

The focus of the present study, on the contrary, requires at least a brief investigation on personnel training and the actual construction and commissioning of the plant. Drawing on Italian technical papers of the time it is possible to estimate that in 1958 Italian universities offered a total amount of 67 places in post-degree courses with varying syllabi⁵³. Among them, the course at the Politecnico in Milan – established back in 1950 – was for sure the most important and it drew on collaboration with the Institute of Physics of the local university, the national nuclear authority and a private applied research laboratory, as well as the availability of a homogeneous training reactor⁵⁴. All in all, this was admittedly not very much.

Moreover there were actual constraints to the scope of intra-mural training

51. On the events leading to Fanfani's downfall and its meaning for Italian political history see Giorgio Galli, *Storia della Democrazia Cristiana*, Roma-Bari, Laterza, 1978, pp. 188-190. Agostino Giovaquoli, *Il partito italiano. La Democrazia Cristiana dal 1942 al 1994*, Roma-Bari, Laterza, 1996, pp. 91-94. Maurizio Degl'Innocenti, *Storia del PSI, Dal dopoguerra a oggi*, Roma-Bari, Laterza, 1993, pp. 258-261.

52. UKNA, AB 16/2054: NPPC-A.N., contract for the provision of services in the construction of a gas-cooled nuclear power station at Latina, Italy, 29 Jan. 1960; NPPC-SIMEA, extracts from contract relating to the construction of a gas-cooled nuclear power station at Latina, Italy, 29 Jan. 1960.

53. "Primo corso di perfezionamento in fisica nucleare applicata presso l'Università di Padova", *Notiziario Comitato Nazionale per le Ricerche Nucleari*, anno IV (1958), n. 1, pp. 37-38. "Secondo corso di perfezionamento in fisica nucleare applicata", *ivi*, anno IV (1958), n. 2, pp. 99-100. "Corso d'avviamento all'ingegneria nucleare", *ivi*, anno IV (1958), n. 3, p. 165.

54. Giuseppe Bolla, "Il Centro Studi Nucleari E. Fermi del Politecnico di Milano", *Energia nucleare*, vol. VIII (1961), n. 11, pp. 673-675. "Il centro di studi nucleari intitolato alla memoria di Enrico Fermi è stato inaugurato", *Notiziario Comitato Nazionale per le Ricerche Nucleari*, anno III (1957), n. 8, p. 425. 55. ASEN, AM.V.6-105-44C3: relazione sul 1° corso d'addestramento per laureati, 9 Nov. 1957.

47. ASEN, BE.I.3-6-24FE: *verbale della seduta della Giunta Esecutiva del 20 giugno 1958*, n.d.

48. UKNA, FO 371/140637: *Christofas to Cape*, 14 Jul. 1959. ASEN, BE.III.2-24-7A: *verbale del consiglio d'amministrazione dell'Agip Nucleare del 24 novembre 1961*, n.d.; *verbale del consiglio d'amministrazione dell'Agip Nucleare del 6 febbraio 1962*, n.d..

49. My translation. ASEN, material waiting stock-taking: *verbale del Consiglio dell'ENI del 30 giugno 1959*, n.d.

50. My translation. ASEN, material waiting stock-taking: *verbale del Consiglio dell'ENI del 28 giugno 1961*, n.d.

within Agip Nucleare⁵⁵, in spite of the construction of a well-equipped laboratory and the collaboration of some distinguished physicists like Antonio Lovati and Pietro Caldirola⁵⁶. At San Donato Milanese, in the outskirts of Milan, Agip Nucleare built in 1957 a laboratory complex for the dual purpose of training and research equipped with an analog reactor simulator and a vast specialized library. By 1959 the equivalent of £80,000 of the time had been invested in technical equipment. But this was not enough to train a 250-people staff for Latina according to a schedule that initially estimate criticality in mid 1961⁵⁷.

The problem was solved resorting to a mix of initiatives. Most people received a background in reactor physics and nuclear techniques in the theoretical courses organised by the Authority (the Harwell Reactor School and other special courses 'customised' according to one's need); then part of them proceeded to attend the six weeks at the Calder Operating School in order to develop familiarity with the reactor prototype⁵⁸. A few senior officers spent a much longer period in Britain, being seconded to the NPPC commissioning division.

Agip Nucleare insisted that these people developed both a deep knowledge of the plant and a command of testing techniques and commissioning procedures, being attached first along with personnel of the Central Electricity Generating Board to the commissioning team at Bradwell nuclear power station and then to Latina⁵⁹.

In such a way this Italian staff was supposed to grant to Agip Nucleare a greater degree of autonomy had a new order for a gas-cooled reactor ever materialised. For sure, difficulties and even clashes with the British did occur, especially with the head of NPPC commissioning division.

« [...] if we left Farkasch free hand, it might happen that our engineers serve nothing but as desk calculators of the English and how can we be sure that this does not occur if Farkasch refuse to be answerable for what he does⁶⁰? »

In any case such difficulties did not seriously compromise the programme: in 1960 some 40 people were sent to the UK for training purposes⁶¹; by the end of 1961, 89 members of the staff had successfully completed their training activities and the whole staff was ready

when the station was connected to the grid in 1963⁶².

Along with training, cooperation in research and development did take place between NPPC and Agip Nucleare. At the end of 1959 an irradiation programme was started in order to develop a new fuel element based on a metallic uranium alloy that would allow a higher thermal output though with a lower enrichment grade compared to the standard element of an Advanced Gas-cooled Reactor (AGR). The first rig was irradiated in Ispra reactor during 1961 and then analyzed in cooperation with the Italian public authority, Consiglio Nazionale per l'Energia Nucleare (CNEN), at its Casaccia laboratory. Actually Agip Nucleare developed a different concept of AGR, called ANGR, in collaboration with the design team of the NPPC chief engineer for research, Antony Robson⁶³. This concept was submitted to the Euratom Commission in order to get the necessary finance for the development phase. It did pass all technical checks, but it was not eventually financed. Actually, the French Commissariat à l'énergie atomique (CEA) was not willing to see Community's money used to fund applied research in gas-cooled reactors – at the time the centrepiece of France's nuclear power programme; all the same, the Commission's director-general for research,

Jules Guéron, was very cool at Italian proposals⁶⁴. When in September 1960 the joint Agip Nucleare-NPPC-CNEN project seemed eventually on the point of succeeding, with the Commission accepting in principle an extension of Euratom five-year research programme to gas reactors, the French – who had actively opposed such a course up to the very end – abruptly changed their mind and tabled their own project for nuclear ship propulsion⁶⁵. Their aim was patently to absorb all funds available, while the ANGR was "left buried on Guéron's desk"⁶⁶.

Works on the site

Considering the construction and commissioning of Latina allows the conclusion that one basic accusation against Mattei, namely that the plant was right from the beginning an already obsolescent copy of Bradwell, was not true. The higher degree of experience in the vessel design allowed the use of steel plates of greater thickness, which – together with a new internal insulation – made possible to increase the pressure of carbon dioxide, so the reactor power. This led to a completely different configuration compared to Bradwell: not a plant with two reactors of 150 MW each, but a single reactor of 200 MW, which made Latina the most powerful peaceful

55. ASENI, AM.V.6-105-44C3: *relazione sul 1° corso d'addestramento per laureati*, 9 Nov. 1957.

56. On the role of Lovati and Caldirola – respectively head of the Group on physics problems and global adviser for technical-organisational affairs in Agip Nucleare – in the 'foundation' of physical studies in Milan see Leonardo Gariboldi, "La nascita e i primi sviluppi degli studi di fisica, *Annali di storia delle università italiane*, vol. 11, 2007, available online at http://www.cisui.unibo.it/annali/11/testi/16Gariboldi_frameset.htm.

57. ASENI, BE.III.2-24-7A: *verbale del consiglio di Agip Nucleare del 25 luglio 1957*, n.d. ASENI, BE.III.2-24-77: *verbale dell'assemblea ordinaria di Agip Nucleare del 29 aprile 1958*, n.d. ASENI, BE.III.2-24-77: *verbale dell'assemblea ordinaria di Agip Nucleare del 30 aprile 1959*, n.d.

58. UKNA, AB 16/2054: *NPPC to UKAEA*, 19 Nov. 1957. UKNA, AB 16/2284: *note by Cartwright*, 25 Nov. 1959. See Mauro Elli, "Scienza e ragioni di politica estera nel Regno Unito. Il caso della Harwell Reactor School, 1954-1963", *Ventesimo Secolo*, anno IX, 2010, pp. 93-114.

59. ACS, SIMEA, busta 471, cartella 1704: *Cole to Cunningham*, 19 Nov. 1958; *report by Martinoli*, 20 Feb. 1959; *Martinoli to Cunningham*, 3 Mar. 1959; *aide-memoire on SIMEA staff and power station*, 14 May 1959; *note of a meeting in Milan on 21 October 1959*, 23 Oct. 1959; *aide-memoire*, 17 Nov. 1959.

60. ACS, SIMEA, busta 471, cartella 1703: *lansiti to Quojani*, 22 Jul. 1960.

61. ASENI, R.III.5-57-3965: *verbale dell'assemblea ordinaria e straordinaria della SIMEA del 28 aprile 1961*, n.d.

62. ASENI, R.III.5-57-3965: *verbale dell'assemblea ordinaria e straordinaria della SIMEA del 26 aprile 1962*, n.d.; *verbale dell'assemblea ordinaria e straordinaria della SIMEA del 24 aprile 1964*, n.d.

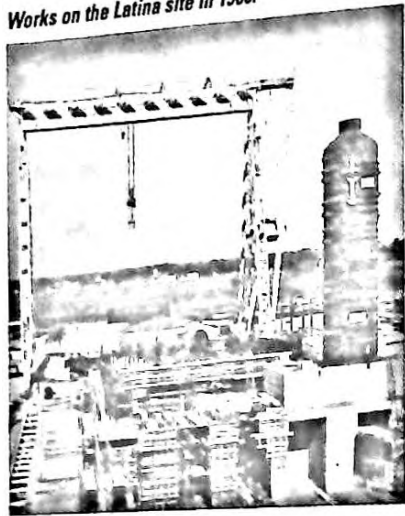
63. UKNA, AB 59/1: *Gale to Hohler*, 28 Aug. 1959. UKNA, AB 16/2549: *note for the record by Croome*, 15 Jun. 1959. ASENI, U.II.6-25-29B4: *Agip Nucleare's activities by December 1961*, 10 Jan 1962. UKNA, AB 16/2054: *note on a visit to the Latina nuclear power station*, Apr. 1960; *note by Hitchman to Cook*, 4 May 1960; *Orford to Burkitt*, 11 Aug. 1960.

64. ASENI, I.V.4-280-484F: *aide-memoire on Agip Nucleare-Euratom relations*, 20 May 1960; *visit to Brussels on 20-21 June 1960*, 22 Jun 1960; *De Peverelli to Gallone*, 22 Jul. 1960; *meeting between Agip Nucleare and Euratom held at Ispra on 23 August 1960*, n.d.

65. ASENI, I.V.4-280-484F: *summary note on a meeting held at Royaumont on 17-18 September 1960*, n.d.

66. ASENI, I.V.3-279-484C: *aide-memoire*, n.d. [end 1961].

Works on the Latina site in 1960.



atomic pile in Western Europe⁶⁷. Many other improvements were implemented. Among them, the procedure of irradiation annealing to avoid the Wigner effect in the graphite, which had caused the fire at Windscale in 1957, and a number of safety measures in the event of earthquake. Neither the operation of the trip circuit nor the insertion of the control rods required the continuity of power supply. Control rods simply fell under gravity into the core once the supply had been interrupted. In the case of a cataclysmic event disaligning the core, the rise of coolant temperature would release absorbing metal balls from a magazine into channels. The rationale was guaranteeing that no overheating could occur

while the pressure circuit remained intact and the reactor was tripped⁶⁸.

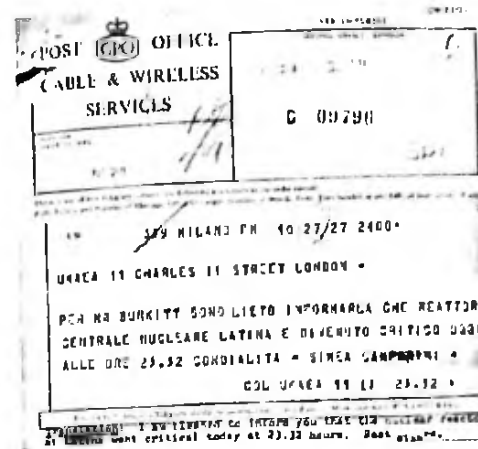
Relations between the British and Italian counterparts on the construction site were good, even cordial, in spite of occasional moments of tension and the scathing controversy on the cost of the plant. Writing to Mattei in September 1962, the chairman of then The Nuclear Power Group (TNPG), Edwin McAlpine, noted:

« I felt most encouraged, on my visit to Latina, to find such a healthy spirit of cooperation and mutual respect between the personnel of our two organizations on the site, and I have a very deep sense of gratitude to you personally because it has become so obvious to me that, whenever I bring to your notice any point which is liable to become contentious or which entails technical problems, it is dealt with almost immediately [...]»⁶⁹.

At a lower level, TNPG resident engineer at Latina went even lyric in his final report on the site works in mid 1963:

« In a project of this nature and proportions [...] it was unavoidable that differences of opinions would occur; but whilst these were not over-frequent or of sufficient magnitude to cause any great concern, and particularly as they were mostly of a constructive nature, they were, nevertheless, dealt with by the respective parties assembling to study the situation in open discussion. [...] At the outset of construction work at Latina

Original cable informing the UKAEA of Latina first criticality (U.K. National Archives).

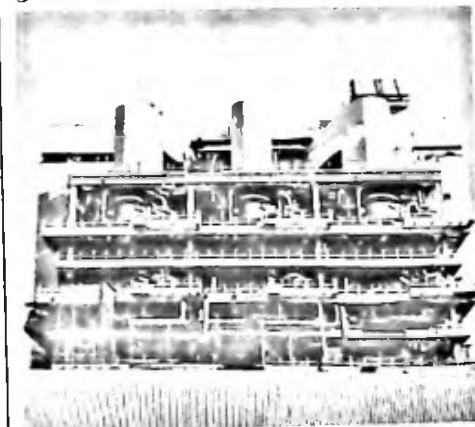


there were many of the Italian Staff who had not a full command of the English language and likewise the British had a very limited knowledge of Italian, but there was one language which was understood by both, and that was the universal language of good fellowship. [...] The Latina Project has manifestly proved how two Nations, united and striving to arrive at a common objective, in spite of certain different trends of thought, method, habit and language, have, with the correct individual concordance and collective effort, triumphed in obtaining the benefits of mutual understanding and wise intercouncil which have been a contributory essence to the general progress. For this, an equal hand-shake is due to British and Italian

Staff alike for a job accomplished in the best possible working harmony⁷⁰.

Starting works on site in autumn 1958, the plant went critical on 27 December 1962, with a delay of some 14 months compared to the initial schedule. Latina was the first nuclear power station operating in Italy, after a relatively smooth commissioning compared to the other two plants using American reactors. The Italian industry provided more than 50% of the components, limiting imports to essentially the nuclear part of the plant⁷¹. The British praised especially the civil works and the six great heat exchangers with their 35 km of piping⁷². By mid 1960s the reactor was operating with a remarkable load factor of 85%⁷³.

In any case reactor at Latina did not escape to an inner deficiency of the gas-cooled line, namely the corrosion



Works on the Latina site in 1960.

67. See Roger Vaughan, Girolamo Calabria, "Comparisons with Bradwell", *Nuclear Engineering*, vol. IV (1959), n. 41, pp. 331-332. "Applicazioni ed attività industriali", *Energia Nucleare*, vol. VI (1959), n. 1, pp. 85-86. Girolamo Calabria, "Notizie sulla centrale nucleo-termoelettrica di Latina", *Energia Nucleare*, vol. VII (1960), n. 6, p. 389-68.

68. UKNA, AB 16/2549: note on a visit to Italy, April 12-13th, 1959, s.d. Calabria, "Notizie...", cit., pp. 390-392. Vaughan, Calabria, "Comparisons...", cit., p. 333. T. Conon, "Layout of the Controls", *Nuclear Engineering*, No. 1. Pile on 10th October, 1957, Cmnd. 302, London, 1957 and Lorna Arnold, *Windscale 1957: Anatomy of a Nuclear Accident*, Basingstoke, Palgrave Macmillan, 2007.

69. ASEN, H.IV.1, 2, 4D3; McAlpine to Mattei, 17 Sep. 1962.

70. ASEN, H.IV.1, 2, 4D3; *The Value of Pre-Planning, Coordination and Mutual Understanding*, 22 May 1963.

71. First Export Reactor, *Nuclear Engineering*, vol. IV (1959), n. 41, p. 328.

72. ASEN, H.III.5, 90, 656; *rassegna stampa ENI n. 252*, 26 Oct. 1960. UKNA, AB 16/2054: *speeches made at the Latina power station site on 25 October 1960*, n.d. "Notizie italiane", *Notiziario. Comitato Nazionale per le Ricerche Nucleari*, anno IV (1958), n. 1, pp. 24-26. "I lavori per la centrale elettronucleare di Latina", *Energia Nucleare*, vol. VII (1960), n. 1, p. 64. "Reattori", *ivi*, vol. VII (1960), n. 12, p. 871.

73. For a comparative chart of the performances of Italian power stations see Luciano Sani, "La produzione di energia elettrica da fonte nucleare in Italia", *Rivista professionale dell'Ordine degli ingegneri di Roma*, anno V (1992), n. 19-20, partly reprinted in Carlo Lombardi, "La questione dell'energia nucleare", in Giovanni Zanetti (ed.), *Storia dell'industria elettrica in Italia, vol. 5: Gli sviluppi dell'ENEL, 1963-1990*, Bari-Roma, Laterza, 1994, p. 605.

engendered in the system by the action of carbon dioxide. In February 1969 the Authority advised Ente Nazionale per l'Energia Elettrica – ENEL, the state-owned electrical monopoly – to inspect the reactor during the scheduled shutdown. The inspection showed very thick layers of oxide and considerable mechanical damages, of a greater extent compared to CEBG reactors. The reason consisted in the use of silicon steel of poor quality, as the content in silicon worked as an antioxidant at different temperatures⁷⁴.

In the period from 1969 to 1972, the UKAEA help ENEL to obtain successive provisional operating licences from Italian authorities. Indeed, the latter were demanding an assessment of the reactor safety after the strong earthquake that had struck Sicily in 1968⁷⁵. Accordingly, the Authority installed a boron injection system as an additional safety and provided a considerable amount of documentation to assess the stress of the core restraint structure. In the while, a series of seismic studies and simulations confirmed the plant safety, though – out of corrosion – its output was scaled down from 200 to 160 MW⁷⁶. Even in this period, between 1971-72, the load factor was 78%. At the

end of its life, the utilisation factor of Latina was 72,9% compared to 61% and 48,9% for the boiling water and pressurized water reactor respectively⁷⁷.

In conclusion, it is safe to say that Latina was a successful story. The British industry indeed was successful in its first export station because it was considered as the best option in order to acquire know-how, a good partner to cooperate with and because it offered ample guarantees. There were serious flaws, however: a tendency, at least on the part of the Authority, to overestimate its standing and – on the other hand – to belittle the technical deficiencies of the system; moreover, an apparently genuine difficulty in cost forecasting, with the consequent loose control on cost escalation. These aspects, which would deserve wider investigations and a comparison with the other export station sold to Japan, are likely to have played an important role in making gas-cooled reactors less competitive than their water counterparts in a limited market. For her part Italy did not materialise as a nuclear outlet in the event, though it remained for a long time a valuable source of revenue for the UKAEA as far as fuel services were concerned.

NUCLEAR REACTIONS NUCLEAR POWER - PAST, PRESENT, FUTURE? Oxford Workshop 5-6 May 2011

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Résumé

Dans ce témoignage, Walt Patterson revient sur les interrogations qu'il a toujours eues au sujet du coût d'opportunité de l'énergie nucléaire et explique que, si les accidents ne mettent pas du jour au lendemain fin à l'énergie et au pouvoir nucléaires, ils leur rendront le soutien financier nécessaire, de la part des gouvernements élus démocratiquement, de plus en plus compliqué.

Abstract

In this account, Walt Patterson shares with us the questions he has always had concerning the opportunity cost of nuclear energy and explains how, if accidents will not put an end to nuclear energy and power overnight, they will, however, further complicate the necessary financial backing of democratically elected governments.

74. UKNA, AB 65/779: consultancy on Latina steel corrosion, n.d.; *Studio del comportamento degli acciai soggetti all'azione ossidante della CO2 della Centrale di Latina*, 23 Mar. 1970.

75. UKNA, AB 65/779: Goodwin to Moore, 20 May 1970; note for the record by Allday, 4 Jun. 1970; Moore to ENEL-DGCT, 5 Jun. 1970.

76. UKNA, AB 65/779: McTighe to Marsham, 11 Aug. 1970; Sani and Belelli to Moore, 22 Oct. 1970. UKNA, AB 65/780: meeting with ENEL, 30 Apr. 1971. UKNA, AB 65/780: report on Latina operations July 1971 – July 1972, n.d. 1971, 13 Sep. 1971; report on Latina operations July 1971 – July 1972, n.d.

77. Lombardi, "La questione dell'energia nucleare", cit., p. 605.