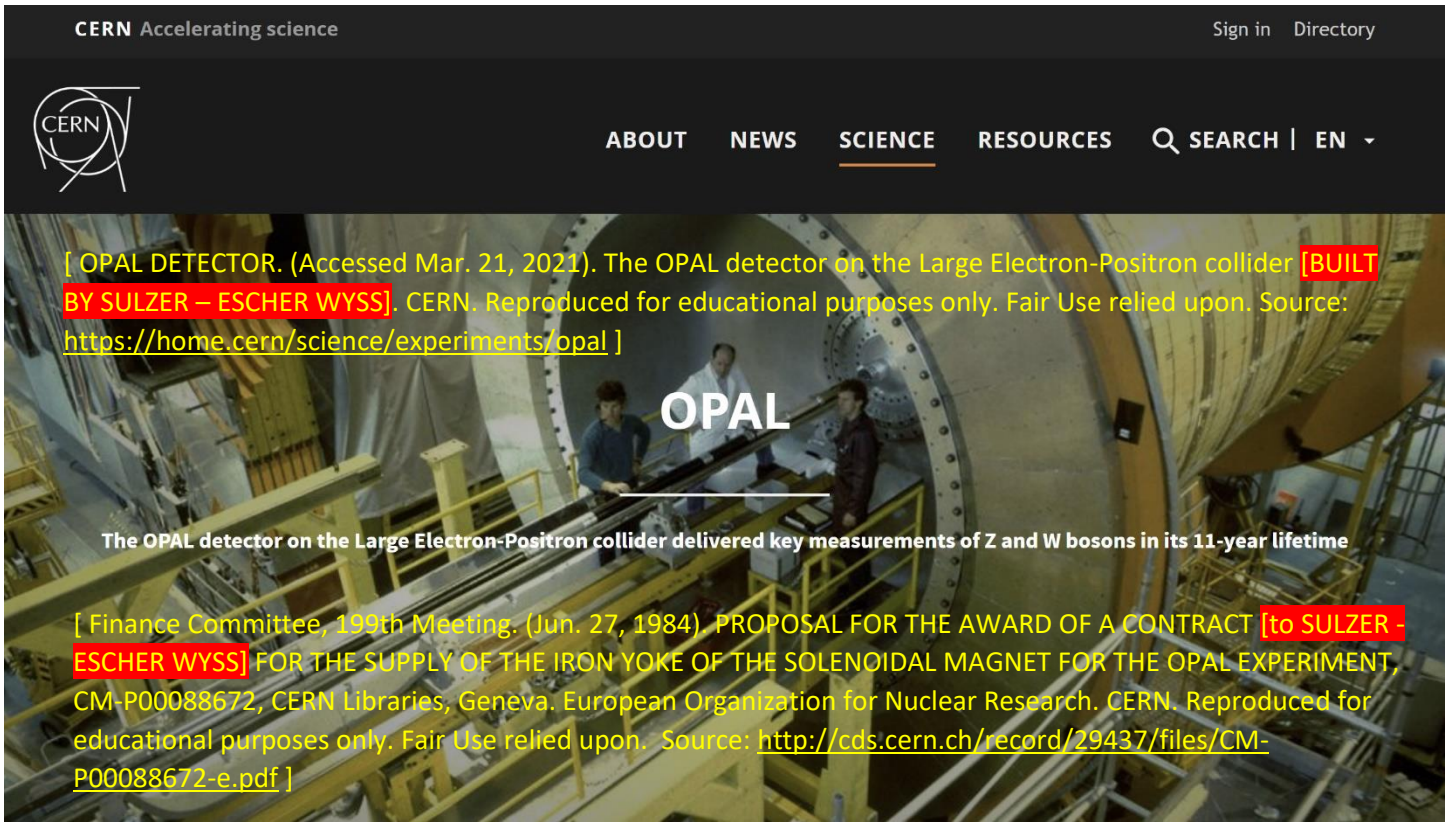

OPAL (Omni-Purpose Apparatus at LEP) was one of four large detectors on the Large Electron-Positron collider (LEP). It started operation along with the collider in August 1989. Data taking for OPAL ended on 2 November 2000 and the detector was dismantled the following year to make way for construction of the Large Hadron Collider (LHC).

The OPAL detector was about 12 m long, 12m high and 12m wide. Detector components were arranged around the beam pipe, in a layered structure like that of an onion. OPAL's central tracking system consisted of (from the beam pipe out) a silicon microvertex detector, a vertex detector, a jet chamber, and z-chambers.

The silicon microvertex detector and the vertex chamber worked together to locate decay vertices of short-lived particles, and to improve the momentum resolution. The central jet chamber identified particles from how much ionization they caused, and how far they curved in the magnetic field. These chambers worked well to

identify tracks in the plane perpendicular to the beam axis. They were complemented by "z-chambers" at the outside edge of the jet chamber, to provide precise measurements of the perpendicular coordinates of the tracks.

Further out from the beam pipe, OPAL's calorimeter system was divided into electromagnetic calorimeters (to identify electrons), hadron calorimeters (for hadrons) and forward calorimeters placed around, and close to, the beam pipe at the two ends of the detector to catch particles thrown forwards by collisions in LEP. Muon detectors formed the end caps of the detector.

In its first phase of operation from 1989 to 1995, electrons and positrons collided in LEP at 91 GeV. The aim was to produce Z bosons. OPAL accumulated millions of these Z events for high-precision measurements. In LEP's second phase from 1996 to 2000, the collider's collision energy was increased to make pairs of W bosons, and to search for possible new particles and new physics.

Z boson OPALW boson weak force

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CONFIDENTIAL

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

FINANCE COMMITTEE

Hundred-and-ninety-ninth Meeting

Geneva - 27 June 1984

PROPOSAL FOR THE AWARD OF A CONTRACT FOR THE SUPPLY OF THE IRON YOKE OF THE SOLENOIDAL MAGNET FOR THE OPAL EXPERIMENT

This document concerns the award of a contract for the supply of the iron yoke of the solenoidal magnet for the OPAL experiment.

The cost of the magnet is supported jointly by all the participants in the OPAL Collaboration. CERN, as a participant, contributes towards meeting 37.9% of this cost.

A call for tenders was sent on 20 February 1984 to the 46 firms selected in twelve Member States. By the closing date, CERN had received offers from 29 firms.

The Finance Committee is invited to agree that a contract be negotiated with SULZER - ESCHER WYSS, the lowest bidder, for the supply and the assembly at CERN of the iron yoke of the solenoidal magnet for the OPAL experiment at a total net price of 4 807 600 Swiss francs, not subject to revision.

CERN's participation in this amount is 1 822 080 Swiss francs, the remaining sum being borne by other participants of the OPAL Collaboration.

PROPOSAL FOR THE AWARD OF A CONTRACT FOR THE SUPPLY OF THE IRON YOKE OF THE SOLENOIDAL MAGNET FOR THE OPAL EXPERIMENT

INTRODUCTION

1 A collaboration between CERN and other laboratories has been set up in order to carry out experiments at LEP with an experimental facility called OPAL. This facility includes a large solenoidal magnet equipped with a conventional coil and producing an axial uniform field of 0.4 T in a useful volume of about 85 m^3.

2 This magnet is part of what is called the "common items" of the experiment, the cost of which is supported jointly by all the participants of the OPAL Collaboration. CERN, as participant, contributes towards meeting 37.9% of this cost and has, in particular, been asked by the Collaboration to provide the design and negotiate the contract for the construction and delivery of the iron yoke of this magnet.

3 The iron yoke, having a mass of approximately 2500 tons, is composed of a central part and two side parts. The central part and the two side parts are essentially constituted by stacks of rolled steel plates assembled so as to permit the interleaving, as completely as possible, of flat particle detectors. The tolerance requirements concerning the plate flatness and thickness, as well as the overall dimensions, are quite stringent and imply considerable know-how and equipment in the manufacturer's workshop. Automatic flame cutting, automatic or semi-automatic welding equipment, furnace for stress-relieving treatment, large machine tools and large handling equipment are necessary for the manufacture of these iron modules.

4 The technical auditing of the contract to be adjudicated according to the proposal put forward in this document was carried out in compliance with the procedure approved by the Finance Committee (CERN/FC/2512).

CALL FOR TENDERS

5 Considering that the OPAL magnet yoke is very similar to the ALEPH magnet yoke for which tenders had been opened in December 1983, no preliminary enquiry has been undertaken in the case of OPAL. It was decided that in this case the call for tenders would be sent to all the firms which had submitted offers for the ALEPH yoke.

6 In addition, some firms were added to the tendering list on the request of Finance Committee members, subject to the condition of meeting the qualification criteria.

7 Consequently, the call for tenders, bearing the reference I-1250/EF, was sent on 20 February 1984 to 46 firms in twelve Member States.

8 When the tenders were opened on 2 May 1984, 29 firms had submitted offers, one firm had submitted a partial offer, nine firms had declined and seven did not reply. Table I gives the list of firms consulted and their replies.

ANALYSIS OF THE TENDERS

9 Table II shows the tender prices at the opening of the offers. Some of the tenderers quoted prices subject to revision. All tenderers accepted the delivery schedule as requested by CERN. Some of them were also prepared, if required, to shorten the delivery time.

10 Table III shows a comparison of the twelve lowest offers taking the price revision into consideration. The offers subject to revision were evaluated by applying the annual inflation rates used by CERN for this call for tenders, e.a. 10.3% total for material and labour at the factory and 11.67% for assembly labour to the price revision formula proposed by CERN, taking into account the delivery schedule laid down by CERN. The price revision formula proposed by CERN was accepted, without exception, by the tenderers in question.

11 The lowest offer was made by SULZER - ESCHER WYSS. Detailed technical discussions with the representatives of the firm and a visit to the factory provided convincing evidence that SULZER - ESCHER WYSS is adequately equipped, possesses the necessary know-how and appreciates correctly the problems related to the manufacturing of the OPAL magnet yoke. This firm is specialized in the construction of the very large elements needed in hydroelectric and nuclear power stations. Its quality control corresponds to the high level necessary for these particular requirements.

12 SULZER - ESCHER WYSS would purchase the steel plates required for the yoke in the Federal Republic of Germany.

13 During the detailed technical discussions it appeared that SULZER - ESCHER WYSS had underestimated the time necessary for the assembly of the magnet yoke on the CERN site. Upon re-checking, the tenderer admitted the error and informed CERN that the assembly time would increase from four to seven weeks, implying a new total assembly cost of 100 000 Swiss francs. This increase will raise the contract price from 4 778 100 Swiss francs to 4 807 600 Swiss francs, which amount covers the supply and assembly of a magnet yoke conforming in all points to CERN's specification.

RECOMMENDATION

14 The Finance Committee is invited to agree that a contract be negotiated with SULZER - ESCHER WYSS, the lowest bidder, for the supply and the assembly at CERN of the iron yoke of the solenoidal magnet for the OPAL experiment at a total net price of 4 807 600 Swiss francs, not subject to revision.

CERN's participation in this amount is 1 822 080 Swiss francs, the remaining sum being borne by other participants of the OPAL Collaboration.

TABLE I

LIST OF FIRMS TO WHICH THE CALL FOR TENDERS WAS SENT

COUNTRY	FIRM		REPLY
Austria	ELIN-UNION	Wien	Offer
	SPEZIELEKTRA ESSLINGER	Linz	Declined
	WAAGNER-BIRO	Graz	Declined
Belgium	ATELIERS DE BRAINE-LE-COMPTE & THIRIAU	Braine-Le-Compte	No reply
	COCKERILL	Seraing	Offer
	CONSTRUCTIONS FERROVIAIRES & METALLIQUES	Famillleureux	No reply
Denmark	AALBORG VAERFT	Aalborg	Declined
	DANNEBROG VAERFT	Århus	Declined
	SMIDTH	København	No reply
France	ATELIERS & CHANTIERS MARSEILLE PROVENCE	Marseille	Offer
	CFEM	Suresnes	Offer
	CLECIM	Saint-Chamond	Offer
	SNACRP	La Rochelle	Offer
	TAMARIS	Ales	No reply
Germany (Fed. Rep. of)	DILLINGER STAHLBAU	Saarlouis	Offer
	HOESCH	Dortmund	Declined
	M.A.N.	Gustavsburg	Declined
	NOELL	Würzburg	Offer
	THYSSEN HENRICHSHÜTTE	Hattingen	Offer
	VOITH	Heidenheim	Declined
Italy	ANSALDO	Genova	Offer
	ACCIAIERIA E TUBIFICIO BRESCIA	Brescia	Offer
	CANTIERI NAVALI RIUNITI	Genova	Offer
	BELTRAMELLI	Stezzano	Offer
	NUOVA ITALSIDER	Savona	No reply
	NUOVO PIGNONE	Firenze	Offer
	DE PRETTO - ESCHER WYSS	Schio	Offer
	SALVATORE TRIFONE & FIGLI	Magenta/Milano	Offer
	TERNI	Terni	Offer

TABLE I

LIST OF FIRMS TO WHICH THE CALL FOR TENDERS WAS SENT

(Cont'd)

Netherlands	KON.MIJ."DE SCHELDE"	Vlissingen	Offer
	STORK KETELS	Hengelo	Offer
Norway	KVAERNER BRUG	Oslo	Offer
	NYE FREDRIKSTAD	Fredrikstad	Declined
Spain	BABCOCK & WILCOX ESPAÑOLA	Bilbao	Offer
	DURO-FELGUERA	La Felguera	Offer
	EQUIPOS NUCLEARES (ENSA)	Santander/Madrid	Offer
	LA MAQUINISKA TERRESTRE Y MARITIMA	Barcelona	Offer
Sweden	MEKADEN	Trelleborg	Declined
	SVENSKT STÅL	Borlange	No reply
Switzerland	ATELIERS DE CONSTRUCTIONS MECANIQUES DE VEVEY	Vevey	Offer
	FERRIERE CATTANEO	Giubiasco	Offer
	SULZER BROTHERS	Winterthur	Offer
	SULZER - ESCHER WYSS	Zürich	Offer
United Kingdom	DAVY MCKEE NUCLEAR	Sheffield	Offer
	WHESSOE HEAVY ENGINEERING	Darlington	No reply
	VICKERS SHIPBUILDING AND ENGINEERING	Barrow-in-Furnes	Offer

TABLE II

PRICES AT THE OPENING OF THE TENDERS

(in Swiss francs)

FIRM	EX WORKS	PRICE RATIO	ASSEMBLY	DELIVERED	PRICE RATIO	PRICE REVISION
SULZER - ESCHER WYSS	4 490 200	1.00	70 500	4 778 100	1.00	No
FERRIERE CATTANEO	4 387 200	0.98	135 650	4 927 950	1.03	Yes
ACCIAIERIA E TUBIFICIO BRESCIA	4 827 850	1.07	168 000	5 203 850	1.09	No
COCKERILL	4 565 223	1.02	349 796	5 303 683	1.11	No
CANTIERI NAVALI RIUNITI	4 433 000	0.99	461 000	5 352 000	1.12	Yes
SULZER BROTHERS	5 426 000	1.21	156 000	5 832 000	1.22	No
SALVATORE TRIFONE & FIGLI	5 172 447	1.15	385 135	5 904 879	1.24	No
EQUIPOS NUCLEARES (ENSA)	5 106 475	1.14	190 667	5 940 000	1.24	No
KVAERNER BRUG	5 385 000	1.20	217 000	6 151 000	1.29	Yes
DE PRETTO - ESCHER WYSS	5 765 430	1.28	334 800	6 456 230	1.35	No
NUOVO PIGNONE	5 566 000	1.24	670 000	6 586 000	1.38	No
ACMP	5 962 770	1.33	364 010	6 698 210	1.40	No
ATELIERS DE CONSTRUCTIONS MECANIQUES DE VEVEY	6 398 644	1.42	366 258	6 875 000	1.44	Yes
CFEM	6 116 411	1.36	642 740	6 995 259	1.46	Yes
DILLINGER STAHLBAU	6 602 920	1.47	295 400	7 158 120	1.50	Yes
THYSSEN HENRICHSHÜTTE	6 800 000	1.51	200 000	7 325 000	1.53	No
DAVY/WHESSOE	6 372 915	1.42	297 820	7 433 025	1.56	No
DURO-FELGUERA	6 030 711	1.34	460 590	7 644 501	1.60	Yes
ANSALDO	7 160 900	1.59	144 000	7 661 300	1.60	Yes
CLECIM	7 318 020	1.63	189 125	7 838 670	1.64	Yes
BELTRAMELLI	7 593 300	1.69	241 610	8 358 400	1.75	Yes
NOELL	8 006 400	1.78	369 154	8 845 016	1.85	Yes
ELIN-UNION	7 984 500	1.78	---	9 028 300	1.89	No
BABCOCK & WILCOX ESPAÑOLA	8 287 500	1.85	272 000	9 242 400	1.93	No
VICKERS SHIPBUILDING & ENGINEERING	7 638 577	1.70	545 737	9 442 550	1.98	Yes
LA MAQUINISTA TERR. Y MARITIMA	8 972 320	2.00	375 800	9 899 120	2.07	No
TERNI	8 424 000	1.88	615 500	9 921 000	2.08	No
KON. MIJ. "DE SCHELDE"	7 940 300	1.77	1 190 400	9 925 700	2.08	No
STORK KETELS	9 598 204	2.14	1 496 208	11 907 072	2.49	Yes

TABLE III

PRICES AFTER EVALUATION OF PRICE REVISION FORMULAE

AND PRICES NOT SUBJECT TO REVISION FOR THE 12 LOWEST BIDDERS

(in Swiss francs)

FIRM	EX WORKS	PRICE RATIO	ASSEMBLY	DELIVERED	PRICE RATIO
SULZER - ESCHER WYSS	4 490 200	1.00	70 500 1)	4 778 100 2)	1.00
ACCIAIERIA E TUBIFICIO BRESCIA	4 827 850	1.07	168 000	5 203 850	1.09
COCKERILL	4 565 223	1.02	349 796	5 303 683	1.11
FERRIERE CATTANEO	4 840 880	1.08	151 476	5 397 456	1.13
SULZER BROTHERS	5 426 000	1.21	156 000	5 832 000	1.22
CANTIERI NAVALI RIUNITI	4 894 298	1.09	515 131	5 867 429	1.23
SALVATORE TRIFONE & FIGLI	5 172 447	1.15	385 135	5 904 879	1.24
EQUIPOS NUCLEARES	5 106 475	1.14	190 667	5 940 000	1.24
DE PRETTO - ESCHER WYSS	5 765 430	1.28	334 800	6 456 230	1.35
NUOVO PIGNONE	5 566 000	1.24	670 000	6 586 000	1.38
ACMP	5 962 770	1.33	364 010	6 698 210	1.40
KVAERNER BRUG	5 938 363	1.32	242 155	6 729 518	1.41

1) Corrected price: 100 000 Swiss francs (cf. para. 13).

2) Corrected price: 4 807 600 Swiss francs (cf. para. 13).