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BACKGROUND PAPER ON THE DUBAI ALUMINIUM SMELTER IN DUBAI, UNITED ARAB EMIRATES 1/

by

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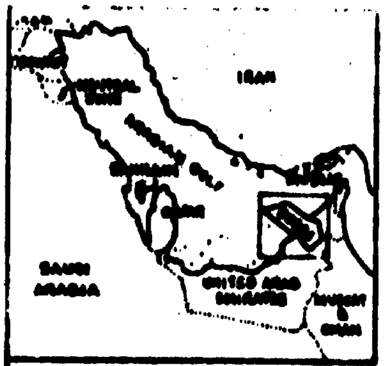

ARABIAN GULF AREA.

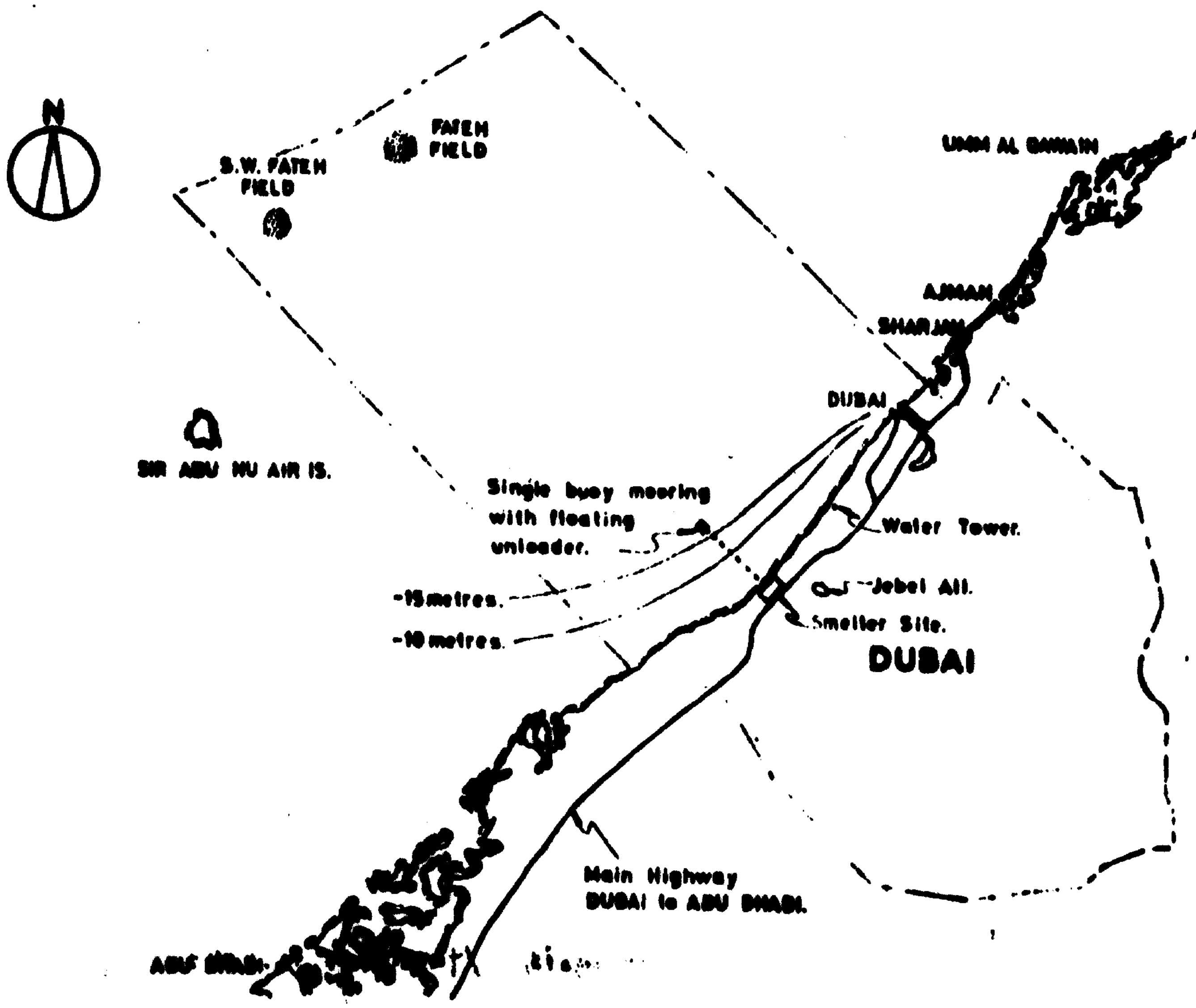

FIGURE 1. ALUMINIUM SMELTER DUBAI.

GENERAL LOCATION MAP.

1. CORPORATE STRUCTURE AND BACKGROUND

On 5 May 1975 Dubai Aluminium Company was incorporated by a Royal Charter signed by His Highness Sheikh Rashid bin Saeed Al Maktoum, Ruler of Dubai. The Dubai Aluminium Company (Dubal) entered into an agreement with British Smelter Constructions Ltd. of Brentford England to construct an aluminium smelter at Jebel Ali capable of producing 135,000 metric tons per year. The Jebel Ali industrial freezone development is approximately 10 km south of Dubai. The development includes a 74-berth port, a new city, an international airport, and several industrial plants besides Dubal.

Dubal is 80% owned by the Dubai Government and 20% by Alusmelters Holdings Inc. Alusmelters is in turn made up by the Southwire Corporation of Georgia, U.S.A., Selection Trust, a U.K. Finance group and a fourth by local Dubai interest.

2. FINANCIAL AND CONTRACTUAL AGREEMENTS

The capital price of the project is $612 million which includes a 25 million gallon per day desalination plant. Of this $225 million is a Eurodollar loan arranged by Morgan Grenfell & Co. Ltd., of London. A loan of £202 million was arranged by Lloyds Bank International Ltd. of London backed by ECGD of the U.K. The final part of the financial package is to be signed shortly with Commertz Bank and Hermes, the German credit authority for approximately DMarks 200 million. The working capital is being arranged with local banks in Dubai.

Dubai has entered into several other agreements besides the construction contract with British Smelters. M+F Engineering Consultants Ltd. of Zurich are to oversee the engineering of the smelter. The technical and operating know-how is being provided by the Southwire Company. Kennedy & Donkin of the U.K. are doing the engineering consulting on the power plant, electrical distribution and the desalination plant.

The desalination plant will produce 23 million gallons of water daily. Of this, the smelter will only absorb 500,000 gallons daily, the rest will go for other developments in the Jebel Ali area and the new city as well as Dubai itself. The British company Weir Westgarth is to provide the plant. The smelter's power complex has been awarded to Hawker Siddeley. The carbon plant is to be provided by a German consortium headed by Klockner Humbolt Deutz, which includes Krupps, Ferrostaal and the Reidhammer companies. Metal services will be handled by the Selection Trust group and the pot rooms and civil engineering work in the complex has been awarded to George Wimpey & Co., an electrical and chemical engineering Construction Company. Costain International will be constructing auxiliary buildings.

3. FACILITY DESCRIPTIONS

3.1 General Site Review

The proposed smelter plant site will be situated in the newly designated industrial area in the vicinity of Jebel Ali, comprising a strip of land approximately 3km long between the Abu Dhabi road and the sea and some 34km southwest of Dubai. Figure No. 1 shows the general location of the site.

The superficial geology of the site area consists of a narrow (500 to 600m) strip of beach and associated dune sands forming a more or less level plateau about 5m above sea level adjacent and parallel to the shore, behind which is an extensive area of low-lying sabkha stretching back across the Abu Dhabi Road. The surface of the sabkha has been cemented, probably by gypsum, to form a crust approximately 300 mm thick overlying generally fine silty sand of unknown thickness with a very shallow water table at about 1.0m below ground level.

3.2 Marine Facilities and Raw Material Storage

The necessary raw materials will be delivered either by bulk carrier or by general cargo vessels to the Jebel Ali industrial harbour to be built in connection with the Aluminium Smelter Dubai and other Industries.

It is assumed that the alumina will be delivered by bulk carriers of 20'000 - 60'000 DWT. Provision will be made for berthing of one 30'000 DWT bulk carrier and one 10'000 DWT general cargo vessel at the same time. Therefore a minimum berth length of 320 m is required. Taking a 60'000 DWT bulk carrier into consideration the maximum draft will be 13 m.

Alumina and petroleum coke will be unloaded by two pneumatic unloader units. The primary conveying system will transfer the two bulk materials to their relevant storage facilities i.e. alumina silos and coke silos. The secondary conveying system will reclaim these materials from the silos and transfer them to the day silos at the plant site. Special control equipment such as level sensors and electrical interlocks shall prevent overfilling of silos, blocking of conveyors and mixing of various raw materials.

A recirculating bucket elevator gives the possibility to transfer the materials within the storage facilities (silos).

Solid coal tar pitch will arrive as bulk cargo. A separate handling system consisting of quayside conveyor, feeding conveyor with tripper and spreader, discharging crane with grab and a charging hopper for appropriate vehicles shall be provided.

General cargo will be unloaded by a general purpose crane and by ship derricks. The materials at the storage areas and between the industrial harbour and the plant site will be handled by forklifts, tractors and trailers.

The port handling facilities will also include all buildings necessary to accommodate the required equipment for utilities and services as well as offices.

3.3 Power Station and Fuel Supplies

3.3.1 Power Requirements

An aluminium smelter complex capable of producing 135,000 MT per annum requires an electricity supply of nearly 300 MW and it is essential that this supply is constantly available.

The power station will be sited within the boundaries of the smelter site and will incorporate sufficient gas turbine generating units to assure the power requirements of the smelter even under the most arduous temperature conditions, and having regard for maintenance shut-downs during those periods.

The power station will consist of eight frame 5 and five frame 9 John Brown Engineering Co. gas turbines. Some 95% of the power generated will be supplied through transformer/rectifier units to the d.c. bus system which feeds the electrolytic reduction process in the potrooms. The remainder serves the auxiliary machines, lighting and small power requirements of the smelter.

Waste heat in the turbine exhaust gases will be utilized by waste heat boilers to provide steam for the desalination plant.

A connection to the proposed near-by D.E.C. Power Station is envisaged which could be utilized by either party to import or export a small amount of power in an emergency, provided, of course, that such standby capacity is available at that particular time.

The fuel will be supplied by Dugas from the Sunningdale L.P.G. plant being built next to the smelter. The gas will be associated gas from the off-shore oil wells.

In the event of an interruption in the main gas supply, a quantity of distillate oil, sufficient for a minimum of 15 days running, will be maintained at all times in storage tanks of 30 days capacity.

Each of the three smelter potlines will incorporate a bus bar system which will be supplied from a block of six transformer/rectifier units each rated at 35,000 amps at a nominal 650 volts. In the event of the failure of one unit, the remaining five can adequately supply the potline.

Aluminium Reduction Plant

4.1 Potlines

Molten aluminium will be produced at the rate of 135,000 MT per annum in three potlines. Each potline will consist of one hundred and twenty, 150,000 ampere reduction cells connected in electrical series but physically each potline is divided into two potrooms housed in separate buildings.

The 60 reduction cells in each building will be serviced by one E.C.L. overhead crane for transporting alumina and bath materials to the cells, anode replacement. Each building will also have one general purpose crane for oring cells, tapping metal and general maintenance. Day-bins for fresh alumina, reacted alumina, cryolite, etc. will be elevated above the centre passage between the two buildings of each potline and the day-bin location will permit the charging of either fresh or activated alumina to the cells. The electrolytic reduction cells will be complete with individual ore hoppers, centre feed, crust breakers, and fume shields. Air Control dry scrubbers will be situated in court-yards between each pair of potline buildings and a central hot metal transfer aisle bisecting the potrooms will be provided for moving molten aluminium to Metal Service or other designated areas.

Each potline will have an office containing rectifier controls and a complete computer input/output terminal. Offices for potroom technicians and a tool store will be located along the central passageway and light refreshment and toilet facilities will also be provided at each potline.

3.4.2 Computer Control

A computer system has been chosen to provide the best use of a computer control through inter-changed information. The system will comprise a central processor and individual mini-computers in the following plant locations:

(a) Rectifier Power Area

(b) Potline No. 1

(c) Potline No. 2

(d) Potline No. 3

The main function of the mini-computer in the Rectifier Power Area will be to ensure the load control on each individual potline while simultaneously preventing excessive peak demands on the power system. In addition, it will provide a continuous sensory control over critical operation parameters associated with the transformers and rectifiers which are normally manually controlled on an intermittent basis in conventional plants.

The principal value of computer control of the potline electrolytic cells will be the ability to rapidly detect and suppress anode effects. An anode effect on any cell interrupts the production of aluminium on the whole potline, and wastes electrical energy. Additionally, the computer will continuously scan the resistance of each cell and will automatically regulate cells deviating from a predetermined resistance target, thus stabilising the delicate thermal balance. This control system will also relieve operators of the task of breaking the crust and feeding alumina on a prescribed schedule.

4.3 Pot and Superstructure Repair

The Pot and superstructure repair facilities will be housed in the building adjacent to the potline building which will allow cell reconditioning to be carried out away from the operating potlines.

The cell superstructure will be repaired in a separate bay, serviced by a 25-tonne overhead crane. Cathode paste will be produced from calcined anthracite coal and soft pitch. Cathode block and collector bar storage will be provided and cathode assemblies rodded as required along-side the repair and relining area.

3.5 Cast House

3.5.1 Metal Services

The Metal Services facilities will be designed to receive and handle 135,000 MT of hot metal per annum and to cast it in a variety of ways to meet long term agreements and day-to-day market conditions. The facilities will be equipped in such a manner as to enable all the cast metal to be despatched either by land or sea.

As the 10,500-pound (4,800 kg) capacity hot metal crucibles are received from the potlines, they will be weighed, sampled and redirected into one of several processes in Metal Services:

(i) The hot metal could be cast directly into 1200-pound sows.

(ii) The hot metal from the remelt furnaces will be capable of charging the holding furnaces at the vertical direct-chill casting facility. The direct-chill castings facility will have the ability of casting extrusion billets, rolling ingots and T-ingots up to 65,000-pounds (29,500 kg) in a single drop for a maximum length of 300 inches (760 cm). The cast products will then be processed through the inspection station and the saw stations.

A homogenizing furnace will be capable of receiving billets up to 25 feet (7.6 m) in length and processing them at a continuous rate of 16,000 pounds (7,300 kg) per hour. The single straight line foundry ingot casting system and stacker will be capable of producing 5 to 12 ingots per minute. The individual ingot size will be 50 pounds (22.5 kg).

(iii) The SCR-3 Aluminium Rod Mill System is designed to produce EC and electrical aluminium alloy rod directly from molten metal on a continuous basis. The hot metal is transferred from the melting furnaces to the holding furnaces and then to the metered pouring pot mounted on the casting machine. After pouring into the casting wheel, the continuous cast bar emerges from the wheel and enteres the rolling mill and after rolling to the finished size, the rod passes through a quench system and is delivered to an automatic dual reel coiler.

(iv) Alternatively, the hot metal could be despatched directly to any adjacent fabricating plant.

3.6 Anode Manufacturing Facility

3.6.1 Green Carbon

The Green Carbon facility will form green anodes and supply furnace packing material to Carbon Baking. Cathode ramming paste, to be used with purchased cathode blocks for relining the pots, will be produced in the Pot and Superstructure Repair area. Raw materials for green anodes will be calcined petroleum coke, pitch, and reclaimed carbon scrap materials.

Calcined petroleum coke will be received from storage, crushed, ground, screened, separated and stored in the precise fractions required to optimize anode density.

Green and baked carbon scrap from the Green Carbon and Carbon Baking facilities, and spent anode butt scrap will be received from the butt crusher and the crushed product will be transferred by conveyor, stored and blended with the calcined petroleum coke.

The various carbon fractions will be weighed and discharged through continuous mixers with a metered proportion of pitch added.

The anode paste mixture will be discharged by conveyor into a hot-oil jacketed vibratory anode forming machine, where the green anodes will be moulded.

Green anodes from the vibrators will be conveyed through a water cooling system to Carbon Baking.

3.6.2 Carbon Baking

The Carbon Baking facility will receive and store green anodes from Green Carbon. The anode storage building will be divided to provide green anode storage at one end, and baked anode storage at the other. Two 15 tonne overhead stacker cranes will be provided for handling green and baked anodes. Sufficient space for extra anodes will be provided in the anode storage area to ensure continuity of Green Carbon and Carbon Rodding operations during major maintenance periods.

The Reidhammer batch type furnaces will be fired with natural gas from overhead manifolds and exhausted into refractory-lined flues which will be connected to high temperature induced draft fans discharging into the exhaust stack.

Each furnace will have a multi-purpose overhead crane, which will place green anodes into the furnace pits. By means of a self-contained pneumatic system, the cranes will place packing material over the anodes to shield them from oxidation. After baking is completed, the cranes will firstly clear the packing material from the pits by vacuum, then remove the baked anodes and place them on the conveyor. These cranes will be equipped with high efficiency air cleaning equipment associated with the pneumatic system. Conveying equipment and storage bins for packing material will be included. Baked anodes will be discharged from the furnace buildings to the baked anode conveyors. After cleaning in an abrasive blast-type cleaner equipped with a dust collector, baked anodes will be inspected and conveyed to baked anode storage or to Carbon Rodding.

3.6.3 <u>Carbon Rodding</u>

Baked anodes will be received from the Baking Furnaces and, after preheating, positioned on a casting wheel. An electrically heated iron-furnace, serviced by a charging monorail, will supply molten pig iron to the pouring monorail, which will permit the pouring of iron into the anode holes to mate the baked anode with the anode rod and yoke assembly.

Anode assemblies will be cleaned of tramp iron and coated with aluminium by a compressed air spraying device. Molten aluminium will be supplied by a holding furnace fired with natural gas. After spraying and inspection, finished anode assemblies will be conveyed to the finished anode assembly storage area prior to being conveyed to the potlines.

An overhead conveyor, supported on an independent floor-mounted structure, will be provided to convey the spent anode assemblies through the recycling process and provide storage for new anodes within the building until required by the potlines. Spent anode assemblies will be returned from the potlines. The cleaned carbon anode butt will be removed from the yoke and rod assembly in the butt removal presses and conveyed to the butt crusher for recycling. The cast iron will be stripped from the yoke in the thimble removal press, cleaned and recycled to the electric furnaces.

The butt crusher will be housed in a separate building. Carbon butts will be crushed in the primary crusher, magnetically cleaned, crushed in the secondary butt crushers, screened, and the crushed carbon conveyed to Green Carbon for re-use.

Dust collection and recycling equipment will be included throughout Carbon Rodding to meet local environmental standards.

3.7 Service Facilities

3.7.1 Site Development and Improvements

Site development and improvements will include the following:

.. Site grading

.. Plant roads and paved areas

.. Parking areas

.. Roadway and parking lighting

.. Fencing

.. Landscaping

.. Storm sewers

.. Ditches

.. Weighbridges

3.7.2 Plant Utilities

Natural gas fuel, compressed air, potable and industrial service water, fire protection, and sanitary waste systems will be provided throughout the plant.

3.7.3 Administration Building

An Administration Building will be provided for the senior administrative staff, accounting, and purchasing departments.

3.7.4 Guardhouse and Personnel Building

The Guardhouse and Personnel Building will be situated at the main gate. Ambulance and fire fighting equipment, including fire tender, will also be located at this point.

3.7.5 Operations Building and Laboratory

An Operations Building will be provided. It will house all operational and maintenance superintendents and general foremen. It also will be occupied by the design engineering, drafting and centralized c[illegible]er facilities.

The Laboratory will be attached to the Operations Building to perform chemical tests and analyses of all incoming production materials, for all carbon materials during process and a complete analysis of all aluminium both during and after manufacture. In addition, adequate chemical and metallurgical back-up will be provided for the reduction plant and production of aluminium.

3.7.6 <u>General Plant Shops</u>

The Maintenance Building will be provided to include a machine shop, garage, electric shop, fabrication and forge shop, carpenter shop, paint shop, and warehouse.

3.8 <u>Social Services</u>

Complete first-aid and medical facilities will be provided within the smelter complex, with nursing staff available at all times.

Changing and wash-house facilities for all operatives will be provided at a central point within the smelter complex.

4. MANNING AND TRAINING

4.1 Manning Table

	Salaried Staff	Hourly Paid	Total
Works Management	2	2	4
Industrial Relations	12	76	88
Administration	24	44	68
Technical	25	44	69
Engineering-Design	28	12	40
Total General and Administration			
Operations	82	849	931
Maintenance	40	398	438
Labour		40	40
TOTAL	213	1,465	1,678

4.2 Training

Training programmes and facilities will be provided for all personnel prior to start-up and training will be carried out on a continuing basis in all sections of the operational plant.

5. METAL PRODUCTION AND OFF-TAKE

The construction of the plant was started 14th February, with the first metal production to commence in mid-1979 and reaching a full capacity of 135,000 metric tonnes by early 1981. The majority of the facility is designed with capacity to permit the addition of another pot line or a total capacity of 180,000 MT per annum.

The metal produced is committed by off-take agreements with the Southwire Company and Alcan (U.K.) for 40% each. The remaining 20% will go to the Government of Dubai for sale in the Emirates to such companies as Gulf Extrusions who are building an extrusion plant near the smelter. A third of the Governments metal has been allocated to Nissho Iwai. The metal will be trucked to the smelter's assigned berth in the port for shipment.

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