UNITED KINGDOM ATOMIC ENERGY AUTHORITY

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MR. K. L. STRETCH

Mr. K. L. Stretch, Works Manager at Calder Hall, Sellafield, Cumberland, was born in Antigua, British West Indies, in 1917, and was educated at the Merchant Taylor's School, Crosby, and King's College, Cambridge. In 1939 he started his apprenticeship with Mather & Platt Ltd., Manchester, but soon afterwards was commissioned in the Royal Artillery and for three years served mainly with the Super Heavy Railway Artillery in training at Catterick and in East Kent. In 1942 he was transferred to R.E.M.E. on wireless work, and then went to France and Germany with H.Q.15 (Scottish) Division and 29 Armoured Brigade Workshops (11 Armoured Division).

In 1946 he returned to Mather & Platt to complete his training and worked in the Research Department.

He joined I.C.I.Ltd. in 1948 as Instrument Manager at the Hillhouse Works, near Blackpool in the General Chemicals Division. In 1949 he became Deputy Works Engineer at Hillhouse, and in December, 1951, transferred to Salt Division as Design Engineer.

He became a Barrister-at-law after legal studies between 1946 and 1952.

Mr.Stretch, who is married, lives at Sandiway, Cheshire, with his wife and two daughters. He was appointed Works Manager of Calder Hall in August, 1954.

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CALDER HALL WORKS

SUMMARY

The reactor consists of a steel pressure vessel into which is built a graphite structure housing the fuel elements.

The graphite sits on flat steel plates set on a steel grid supported around its periphery in the vessel, and the fuel elements are stacked in vertical channels which form the flow passages for the carbon dioxide coolant gas. The fuel elements are rods of natural uranium in magnesium alloy cans bearing helical fins, so that the gas flows in the annulus between the graphite and the fin tips. Further vertical channels are provided in the graphite to take the rods controlling the reactivity of the pile. The graphite structure is made up of a centre core which houses the fuel elements, and a surrounding reflector.

The pressure vessel is a cylindrical shell with domed ends, set with its axis vertical. The shell is made of 2 inch thick mild steel. The cooling gas (which is at a pressure of about 100 p.s.i. gauge throughout the circuit) enters the bottom dome by four inlet ducts, flows up through the fuel element channels in the graphite core, and is led away to the heat exchangers by four outlet ducts situated above the graphite structure. From each heat exchanger it is returned to the pressure vessel by a centrifugal blower.

A 7ft. thick concrete biological shield encloses the entire pressure vessel and this shield is itself protected from radiation damage by means of a 6 inch thick mild steel thermal shield between it and the pressure vessel.

Calder 'A' covers the following installation:

2 reactors
8 heat exchangers
8 main blowers
4 turbo-alternators and condensers
2 dump condensers
2 cooling towers

FUEL ELEMENTS

(a) Fissile Material

Material	Natural uranium
Density	18.7 gm/cc(0.676 lbs/in^3)
Diameter of rod	1.15 inches
Length	40 inches

(b) Cans

The can containing the uranium fuel has single-start helical fins on a cylindrical barrel sealed at one end by a plug and end cap, and at the other end by a spacer and end cap.

Material	Magnesium alloy
Inside diameter	1.165 inches
Outside diameter	1.30 inches
Diameter of fin tip	2.125 inches

GRAPHITE STRUCTURE

Nominal core diameter	31 feet
Height of core	21 feet
Number of fuel element channels	1696

PRESSURE VESSEL

Inside diameter	37.0 feet
Thickness of cylindrical shell	2.0 inches
Thickness of domed ends	2.0 inches
Maximum internal pressure	100 lbs/in^2 G
Total internal volume	57,500 ft.^{3}

COOLANT

Gas	Carbon dioxide
Temperature at lower end of pressure vessel	140°C
Temperature at upper end of pressure vessel	336°C

FUEL ELEMENT CHARGE AND DISCHARGE

Charge and discharge of fuel elements is carried out from machines which run on rails on the top biological shield. Charge chutes are provided for insertion in the charge tubes to give access from a charge or discharge machine to any of the channels served by the charge tube.

SHIELDING

Concrete Biological Shield

Side Thickness	7'-0"
Top Thickness	8'-0"

HEAT EXCHANGERS

There are four heat exchangers per reactor, each exchanger generating high and low pressure steam simultaneously.

One Heat Exchanger:-

Surface area for heat transfer - the following figures refer to the surface (based on outside of tubes) exposed to live gas.

High pressure superheater	4,700 ft^2	64 elements in parallel (plain tubes)
High pressure evaporator	31,500 ft^2	64 elements in parallel (studded tubes)
High pressure, high temperature economiser	15,750 ft^2	42 elements in parallel (studded tubes)
Low pressure superheater	785 ft^2	32 elements in parallel (plain tubes)
Low pressure evaporator	31,500 ft^2	64 elements in parallel (studded tubes)
Low pressure and high pressure economiser	15,750 ft^2	42 elements in parallel (studded tubes)
TOTAL	99,985 ft^2	

TURBO ALTERNATORS

Number of sets per reactor	2
Maximum continuous rating	23,000 K.W.
(at a power factor of)	0.8 lagging
Speed	3,000 r.p.m.
Generator voltage	11,500 V,3 phase 50 C/S
High pressure steam pressure at turbine stop valve	200 lb/in^2 abs
High pressure steam temperature at T.S.V.	590°F (310°C)
High pressure steam per set (77% total)	198,000 lb/hr.
Low pressure steam pressure at T.S.V.	53 lb/in^2 abs.
Low pressure steam temperature at T.S.V.	340°F (171°C)
Low pressure steam per set (23% total)	59,300 lbs/hr.
Output	21,000 K.W.
Flow rate to condenser per set	257,300 lbs/hr.
Absolute pressure at turbine exhaust flange	1.75 inches Hg.
Maximum cooling water temperature	85°F (29.4°C)

COOLING SYSTEM

There are two cooling towers with split basins, and one pump house, serving the two reactors. The half-basin capacity is 687,500 gallons. The two towers feed into a common suction basin at the pump house with dam boards for partial shut down. Five pumps are available for delivering the water to the condensers of the two reactors.

Cooling Towers

Cooling range	87^{o}F to 70^{o}F(30.5^{o}C - 21.1^{o}C)
Capacity (per tower)	3×10^{6} gallons/hour
Wet bulb temperature	47^{o}F (8.3^{o}C)
Dry bulb temperature (humidity 60%)	52^{o}F (11.1^{o}C)
Tower height above sill	290 feet
Tower diameter at ring beam	200 feet
Throat diameter	104 feet

MISCELLANEOUS

The above details are identical for Calder 'B'.

Construction of Calder 'A' started August 1953.

Construction of Calder 'B' started towards the end of 1955 and should be completed in 1958.

Maximum labour force engaged in construction, 1,500.

With the compliments of Andrew Reid, 17 Fleet Street, London, EC.4.
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CALDER HALL - CIVIL ENGINEERING ACHIEVEMENT

New and unusual civil engineering problems had to be overcome in the building of the world's first atomic energy power station, Calder Hall, Cumberland, England, which is being opened by H.M. The Queen on October 17.

The work was ahead of schedule throughout, however, the main civil engineering work being finished in 12 months and the whole of it in 33 months.

The building and civil engineering contractors, Taylor Woodrow of London, are now working on the second station to the order of the United Kingdom Atomic Energy Authority, Calder Hall 'B', and by November it will be about 75 per cent finished.

The part of the work calling for the greatest care was the construction of the reactor buildings, each 120 ft. high. Higher standards of accuracy were required than are usual in civil engineering construction.

The walls of the biological shields, to provide protection against radio-active emanations, 90 ft. high and 7 ft. thick, were constructed to tolerances of plus or minus one-tenth of an inch. The 20 ft. long vertical charge tubes, along which uranium is fed to the reactor core, could not be out of line more than three-sixteenths of an inch.

Concrete of unusual density (not less than 150 lbs. per cubic ft. compared with the normal 145 lbs.) was used. Steam-heating and the use of calcium chloride enabled concreting to go on in the coldest weather.

Months were saved by installing the pressure chamber in the partly erected shield instead of building the shield round the positioned vessel.

This involved one of the biggest "lifts" on a job on which cranes, derricks and lifting gear of every description were used to the utmost to save time, specialist contractors being used. The sectional rings of the pressure chamber were lifted into place by a 100 ton, 200 ft. high derrick, guyed with 800 ft. long steel hawsers.

With the pressure vessel complete inside the shield the reactor was encased by a reinforced concrete roof slab 8 ft. thick, painstakingly cast round the large number of charging, viewing and other tubes to ensure a perfect seal.

Each reactor building was founded on a concrete raft, 130 ft. by 107 ft., and 11 ft. deep, the volume of concrete in each raft being 5,600 cubic yards, reinforced with 270 tons of steel.

The labour force on the civil engineering work was from 120 employed by the end of the first week to a peak of 1,100.

END

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RELEASE MATERIAL FOR NEWSREELS

Britain is pushing ahead rapidly with the building of its Atomic Power Station in Cumberland - the first of its kind in the world. Construction started last year on a site next to the Windscale plutonium factory, and these newly released pictures give an idea of the progress being made.

Atomic energy - so long considered only as a destructive force - will here be harnessed to peaceful uses.

The main units of this station are two atomic piles consisting of uranium embedded in graphite. Their radioactivity is safely screened by thousands of tons of concrete and steel. When they are working these reactors will generate heat from which will be made steam to drive the turbo-alternators which will supply electricity to the national grid.

So large were the boilers for these reactors that they had to be sent to the site in sections - and transporting these by road over the 150 miles from Glasgow presented some tricky problems - particularly through the narrow streets of small towns and villages, where the clearance between the houses was sometimes only a matter of inches. Careful driving and direction was needed here.

Pre-fabricated sections for this enormous engineering project are being assembled on the site - where fully equipped assembly shops have been built.

A vast camp to house the thousands of workmen, with canteens and other amenities sprang up in a matter of weeks.

To assemble the reactor, hoisting equipment was needed. A crane, known to workers as a "big stick", towering 200 feet above the ground and capable of lifting 150 tons, was erected. The top of the "stick" was held by wire ropes - thick cables - stretching out in all directions. A tricky job this - raising the mast to its platform in high winds and Cumberland gales.

Sir Christopher Hinton, the Atomic Energy Authority's Production Chief - with his engineers - pays a visit to the site - where only eighteen months ago cattle were grazing on this quiet and remote farmland - and where very soon all this labour and skilled engineering effort will result in electricity being generated by Britain's first Atomic Energy Power Station.

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UNITED KINGDOM ATOMIC ENERGY AUTHORITY

MINISTRY OF WORKS AND CALDER HALL

From 1945, when it was publicly announced that the first British Atomic Energy Centre was to be established at Harwell, through to August, 1954, when the United Kingdom Atomic Energy Authority was formed, the Ministry of Works, under the Director General of Works, Sir Charles Mole, co-operated with the Ministry of Supply Atomic Energy Division in the construction of Harwell, Aldermaston and the Atomic Energy factories under the Headquarters Office at Risley. Since August, 1954, Ministry of Works have continued to design, construct and equip the Harwell and Aldermaston Research Establishments and their associated outstations.

In 1946, the Ministry of Supply establishment responsible for the construction of the Atomic Energy factories was set up at Risley under the direction of Sir Christopher Hinton. A strong M.O.W. section, including architects and mechanical, civil, structural, electrical and sanitary engineers, was seconded to Risley and worked in close liaison with the M.O.S. design staff on the various projects, including the Springfields factory, Windscale piles and chemical separation plant, Capenhurst diffusion plant and Calder Hall power station. The M.O.W. staff were generally responsible for all works and buildings, including site construction and the letting of the building and civil engineering contracts.

This arrangement continued until August, 1954, when the U.K.A.E.A. absorbed the M.O.S. and M.O.W. staff who wished to stay with them.

The 1951 - 1952 design study for a gas-cooled, natural uranium power reactor had by the spring of 1952 been developed to the stage when Harwell were able to bring in and seek advice from the British Electricity Authority (Now C.E.A.), M.O.W. and a number of specialist firms. These organisations were brought into the project and their work co-ordinated by Harwell through the Plant Co-ordinating Committee set up in April, 1952. The M.O.W. were involved at that time in the construction of a number of large pressure vessels at N.A.E. Bedford: their advice was, therefore, valuable in the final development of the reactor vessel design and construction. They were responsible for building services and prepared the one-eighth inch scale architectural and structural drawings, together with the capital cost statement for this work. With the B.E.A. and Harwell they prepared a preliminary construction programme.

When the Thermal Reactor Design Office was opened at Risley in April, 1953, M.O.W. contributed a section working under the direction of the Chief Engineer of the project. This arrangement continued until August, 1954, though certain staff continued on the project, after that date. The team was principally engaged on the co-ordination of design work and construction with the pressure vessel contractors and in the design of the thermal shield cooling system. In accordance with previous practice the M.O.W. supplied the main construction team, whose work was co-ordinated with that of the Design Office through the monthly site meetings at Calder.