THE ACCIDENT AT WINDSCALE ON OCTOBER 10, 1957

THE final report* on the accident to No. 1 pile at Windscale on October 10, 1957, should be considered in relation to the previous reports[1–3].

During a routine Wigner energy release, temperatures in the pile rose beyond safe limits, causing a fire which affected 150 channels and caused a certain amount of radioactivity, mainly iodine, to be released over an area of Cumberland. Following this incident, a committee of inquiry was set up under Sir William Penney, and reporting to the Prime Minister. A less technical version of its report has already been published[1]. In the memorandum by the Prime Minister the immediate cause of the accident was given as "the application too soon and at too rapid a rate of a second nuclear heating to release the Wigner energy from the graphite . . .". The accident was considered as being due partly to inadequacies in the instrumentation and partly to faults of judgment by the operating staff, these faults of judgment being themselves attributed to weaknesses of organization.

Three committees were set up, each under the chairmanship of Sir Alexander Fleck, to advise on certain aspects of the incident. The committees on Organization and on Health and Safety reported in December 1957[2] and January 1958[3], respectively. The report of the Technical Evaluation Committee, the subject of this article, was delayed due to the need to carry out a considerable amount of experimental and analytical work.

The Committee's terms of reference were: (1) to consider the new information available following the accident; (2) to consider the possible methods of carrying out the controlled release of Wigner energy; and (3) to advise the United Kingdom Atomic Energy Authority on the restarting of Windscale No. 2 pile.

The report begins by considering the phenomenon of energy storage in irradiated graphite—Wigner energy. This storage is due to defects in the crystal structure of the graphite following neutron bombardment. The energy is releasable, in varying extent and rate, by heating the graphite. The amount of energy stored decreases rapidly with an increase in the temperature at which irradiation takes place, that is, there is an annealing effect. This feature makes the effect particularly severe in low-temperature reactors such as BEPO and the Windscale piles, but very much less important in the Calder and subsequent power-producing reactors. The Committee states that if the release of energy in No. 2 pile was attempted as previously, graphite temperatures in excess of 400° C. would almost certainly occur in considerable masses of graphite, and that temperatures in some pockets where previous releases had not been effective might reach 500° C.

The report next considers the implications of these transient high temperatures on the graphite, the fuel and the other materials in the reactor. A temperature limit of 400° C. is considered as reasonable for the graphite. Under these conditions the fuel element design is satisfactory. Having specified temperature limitations, the real problem is that of installing sufficient and effective instrumentation. A considerable increase in the number of graphite and fuel element thermocouples is required, and the fission product detection scanning gear needs improving.

A description of four methods of carrying out Wigner releases is then given. The first method, the one previously employed, uses nuclear heating to initiate the release of energy. The main difficulty is the non-uniformity in the spread of the release, leaving pockets unannealed. The Committee deprecates the application of a second nuclear heating to initiate the release of these pockets, as being certain to lead to excessive uranium temperatures, and recommends that no further releases by this method should be attempted. The second method was used with the BEPO reactor in March this year, but is not recommended for Windscale. The third method, a slow heating method, is also discarded, since it would cause excessive stresses in the concrete reactor structure. The fourth method combines the previous two. It is proposed that a partial anneal using a slow heating method should first be carried out, followed by a more rapid heating to a somewhat higher temperature. The heat would be supplied by heating the ingoing air. The necessary plant and instrumentation could be installed in 6–9 months, making the pile operational again in about a year.

No. 1 pile has added considerably to our knowledge of reactor technology and operation. It is hoped that No. 2 pile will be recommissioned, since the development of methods for altering the pattern of the instrumentation in a reactor after it has been in service will prove most useful as the nuclear power programme develops.

* Atomic Energy Office. Final Report of the Committee appointed by the Prime Minister to make a technical evaluation of information relating to the design and operation of the Windscale piles, and to review the factors involved in the controlled release of Wigner energy. Pp. 20. (Cmnd. 471.) (London: H.M. Stationery Office, 1958.) 1*s.* net.

[1] Accident at Windscale No. 1 pile on 10th October, 1957. (Cmnd. 302.) (H.M. Stationery Office.) *Nature*, **180**, 1043 (1957).

[2] The organization of certain parts of the U.K.A.E.A. (Cmnd. 338.) (H.M. Stationery Office.) *Nature*, **181**, 439 (1958.)

[3] The organization for control of health and safety in the U.K.A.E.A. (Cmnd. 342.) (H.M. Stationery Office.) *Nature*, **181**, 1023 (1958).

EXCHANGE OF INFORMATION ON ATOMIC ENERGY

THE Agreement between the Governments of the United Kingdom and of the United States for Co-operation on the Uses of Atomic Energy for Mutual Defence Purposes described in the White Paper* published on July 8 comprises twelve articles. The first is a general provision for the exchange of information and transfer of materials and equipment, unless such co-operation represents an unreasonable risk to the defence and security of the communicating or transferring party. Under the second article the two parties agree to communicate or exchange classified information jointly determined as necessary to the development of defence plans, the training of personnel in the use of or in defence

* Agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the United States of America for Co-operation on the Uses of Atomic Energy for Mutual Defence Purposes, Washington, July 3, 1958. Pp. 8. (Cmnd. 470.) (London: H.M. Stationery Office, 1958.) 6*d.* net.