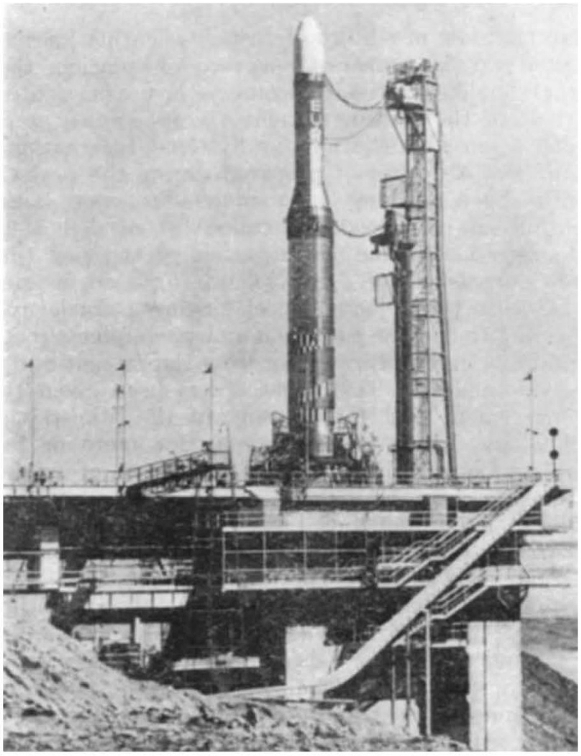
year, designated Flight 6/1 and 6/2, have both failed. The second of these flight tests from Woomera took place last week on December 5. ELDO, the European Launcher Development Organization, is concerned with space tools and not research. The two launches were stages in the development of a large carrier rocket based on the British Blue Streak for European purposes.



Europa I in launch position (ELDO photograph)

The failure of the second launch has marked similarities with that of *F*6/1 on September 2. In both cases the programme sequencer was implicated. This is mounted on the French second stage and both its manufacture and its checkout are French responsibilities. The cause of last week's vehicle failure was very simple: the programme-sequencer did not start at take-off and did not work at all during the few minutes' flight. Consequently the second stage (Coralie) did not separate and because it did not separate it did not fire. The second stage electronics failure on September's *F*6/1 test was more complex. Then the sequencer malfunctioned briefly—possibly for as short a time as 200 milliseconds—during the first/second stage separation phase as Blue Streak boost ended. The consequence was that although the second stage separated it did not fire and a few seconds later was automatically destroyed. On both the *F*6 flights the Blue Streak booster stage functioned "normally", as it has done on the preceding five flight tests.

Apart from giving the first "live" test to the second stage, the objective of *F*6/2 was an operational run of the complete ground network for control and tracking. This was partially achieved. The upper parts of both this year's flight vehicles, representing the German third stage and the Italian test satellite, were dummies though of correct weight and aerodynamic characteristics. Despite the setbacks with the second stage, there is apparently to be no change in the firing schedule for which 12 flight tests of the Europa I configuration extending through to 1970 are laid down. The next flight (*F*7), due next summer, will have all three rocket stages live and will be the first potential orbital flight though not carrying a fully instrumented satellite. Clearly the French will have to do some intensive homework to avoid frustrating this trial and its successors. The *F*6 booster has already completed its tethered test firings at Spadeadam (Cumberland) and is being made ready for shipment from Hawker Siddeley's Hatfield works.

The still distant *F*11 and *F*12 orbital tests may carry components of the perigee/apogee system (PAS)—the key element in converting Europa I into Europa II—or a low polar orbit into the high equatorial type favoured for communications satellites. France heads the list of intending buyers of the Europa II launcher on which she is dependent for her ambitious plans of direct French communications to link metropolitan France with French-speaking territories overseas (SAFRAN and SAROS). Enhanced reality was given to the PAS project last week by the formation of an industrial management company representing the 11 European companies involved in its development for ELDO. Called SETIS (for Société Européenne pour l'Etude et l'Intégration des Systèmes Spaciaux) with a full-time technical staff drawn from these firms, a French president and a Paris headquarters, its chief task will be the coordination and integration of work on PAS. The firms involved are: Hawker Siddeley, Rolls Royce (Britain); SEREB (France); Bölkow, Erno (Germany); C.I.A. (Italy); A.C.E.C., M.B.L.E. and B.T.M.C. (Belgium); Philips and Fokker of Holland.

No Joy for Euratom

EURATOM struggles from crisis to crisis. The latest misfortune to assail the organization is a drastic budget cut, enforced last Friday at the Council of Ministers in Brussels. Although the Euratom commission had proposed a budget of $82 million, the ministers cut this down to $40·695 million after discussions which lasted all day. Even the commission's proposal was modest in comparison with earlier years, when the budget has run at about $90 million.

The budget cuts are only the visible symptoms of a malaise which now threatens the whole future of the organization. As is reported elsewhere in this issue, the Dragon reactor project, by general agreement a successful example of co-operation, is threatened by the inability of Euratom to determine its research programme for 1968. This kind of project, in which Euratom contributes but is not wholly in control, seems to have been a main topic for argument when the ministers met last Friday. All that could be agreed was that these projects would be further considered in the next few months, but no provision was made for them for 1968. At the meeting, France and Italy were both attempting to cut back the budget, while West Germany and Holland supported the commission and Belgium and Luxembourg remained neutral. With the refusal to sanction work on association projects, the only work that can go ahead in 1968 is the work in Euratom's own laboratories.

The French view of the association contracts is that, if the work is worth doing, the money will eventually be forthcoming, but that the contracts must be left in suspension until the new arrangements for co-operation can be worked out. The French argue that it is no longer sensible to produce a grand plan detailing all that needs to be done; instead, each individual decision should be agreed by the Euratom members. This formula, the argument goes, need not be applied rigidly, and if any member of Euratom wanted to opt out of any particular project it could do so, leaving five, four or even three countries collaborating. With this as a basis, it would be impossible for any single country to veto a project which the others wanted to support.

Developing Hovercraft

WHEN the first hovercraft flew nearly nine years ago, it did so without the aid of flexible skirts. The air cushion beneath the craft was kept in place by jets of air around the periphery, which produced a hover height of ten inches. But, as Mr W. C. Crago, Chief Research Engineer for the British Hovercraft Corporation, explained to the Institution of Mechanical Engineers on December 12, this was an unsatisfactory solution. It used far too much power, so much that, without enormous power units, hovercraft designed then would have had a clearance of only about 1 ft., not enough to clear even quite small obstacles. The solution was the invention of the flexible skirt—which offered increases in hard structure clearance by as much as eight times. But the arrival of skirts brought further development problems, and these formed the substance of Mr Crago's talk.

The modern hovercraft skirt, Mr Crago explained, is a sophisticated inflated structure, consisting of an upper bag portion which is more or less self supporting —and acts as a shock absorber in heavy waves—and a series of discrete fingers which hang from it. One of the critical parameters is the pressure inside the skirt. There are two opposing demands—to form a stable structure, skirt pressure should be high, but, to minimize drag and improve hover performance, a low skirt pressure is better—and a compromise, based on model testing, is usually adopted. Hovercraft also demonstrate a form of behaviour known as "plough-in", for which there is no real counterpart in other marine craft. The pictures show this process happening to an SRN 6 hovercraft during trials. As can be seen, the process is started by the contact of the skirt with the water; the drag then causes the nose to dip even further, and if unchecked the process can lead to overturning of the craft. Fortunately, the process is well understood, and Mr Crago said that skirts of low hydrodynamic drag should be used; for this reason, skirts with fingers are particularly suitable. Another possibility under active investigation is the lubrication of the skirts by air, which is blown down the outside of the skirt and reduces drag at the point where the skirt comes into contact with the water. This seems likely to be a very useful development.

As well as the danger of overturning at high speed after plough-in, low speed overturning can sometimes be experienced. This happens at a fixed forward speed, when the length of the wave generated by the air cushion is the same as the length of the craft. Again cushion pressure is an important criterion. Finally, Mr Crago discussed the problem of skirt wear. One of the problems in investigating wear, he said, was that it was difficult to reproduce in the laboratory the type of wear—delamination—shown by the cushions in operation. Ultimately it was found that a specimen mounted in the outlet of an air blower could be made to flap like a flag, and produce delamination of the material much like that observed in practice. As a result the skirts, which consist of a nylon or terylene core coated on both sides with rubber material, have been markedly improved.

An SRN 6 hovercraft "ploughing in". Photograph by permission of the Institution of Mechanical Engineers.