The Spadeadam Blue Streak Underground Launcher Facility U1

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Failed technologies, or technological dead ends are often virtually historically invisible. This is due to the loss or destruction of apparently worthless research data and artefacts, and the tendency of many histories to present a logical linear narrative of progress.[2] *One check on the accuracy of the accounts presented in 'official' histories are the personal recollections of the people involved. Similarly, physical relics, archaeological remains and museum objects may be the only surviving evidence for a failed or abandoned project where accompanying documents are lost. This note describes the recent rediscovery of the trial Blue Streak missile underground launching facility, U1, at RAF Spadeadam, Cumbria*.

Running in parallel with the development of the Blue Streak missile and its warhead discussions were also taking place regarding the best method of launching the missile. A number of schemes were proposed, including mobile launchers or launchers positioned at sea, either as floating platforms or submerged silos.[3] By 1958 the preferred option was for an underground launching facility, or silo, and an addendum was added to Operational Requirement 1139 specifying the criteria it was to meet.[4] At this date underground launching technology was an unexplored field and

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[1] © English Heritage. I grateful to my colleagues Catherine Tuck and David McOmish who worked on the archaeological investigation of RAF Spadeadam and Deborah Cunliffe who drew Figure 2.

[2] For a discussion of the invisibility of another nuclear weapon system see for example, Barton C Hacker, 'Whoever heard of nuclear ramjets? Project Pluto, 1957-1964', *ICON*, Vol.1 (1995), pp.85-98.

[3] For recent discussions of the Blue Streak silo see Roy Dommett, 'Silos for Blue Streak' unpublished essay 1998; Nicholas Hill, *A Vertical Empire The History of the UK Rocket and Space Programme, 1950-1971*, (Imperial College Press: London, 2001), pp.83-90; Wayne D Cocroft and Roger JC Thomas *Cold War Building for Nuclear Confrontation 1946-1989*, (Swindon: English Heritage, 2003), pp.46-8, p.257: Charles H Martin *De Havilland Blue Streak, an illustrated story*, (British Interplanetary Society: London, 2004), p.102; Roy Dommett, 'The Blue Streak Weapon', *Prospero*, No.2, pp.24-7.

[4] Quoted on www.spaceuk.org

the studies undertaken by Great Britain were at least as advanced, or ahead of those being carried out by the Superpowers.

In common with the remainder of the Blue Streak project the design of the underground launching facility was a collaborative effort between many government establishments and the project's principal contractor De Havilland Propellers. The original design requirement for the facility was produced by the Ballistic Missile Division, Guided Weapons Department, Royal Aircraft Establishment, Farnborough, working in close association with J C Clavering of the Ministry of Works, who commented on the design details. In 1956 studies began to examine the design concepts at the Rocket Propulsion Establishment, Westcott, Buckinghamshire. Initially a one-sixtieth model was built and tested using high pressure nitrogen gas.[5] A larger one-sixth scale silo was constructed subsequently and tested using a high test peroxide and kerosene fuelled Gamma rocket engine, a number of segments from this launcher model survive.[6] A model of the silo design is also preserved in the Science Museum collection at Wroughton. The Atomic Weapons Research Establishment Foulness, Essex, was also consulted to assess the blast and earth shock effects that might be caused by an attack on an underground facility. Large test explosions to study blast effects on the design were planned for Foulness and the Suffield Experimental Station, Canada, but were probably never carried out due to the cancellation of the missile project in April 1960.[7]

A key question that needed to be addressed was whether or not it was feasible to develop a fully underground system where the missile could be 'hot-launched' directly from its silo. An alternative, as proposed in some American designs, was to raise the missile to the surface on a lift system prior to launching. One of the principal uncertainties in the use of a hot launch system was whether the acoustic shock produced by the vibration from the engines would shake the missile to pieces before it left the silo. Detailed studies were also conducted into the many variables that might affect the missile as it left the launch tube.[8]

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[5] TNA: PRO: AVIA 68/23 BWA Ricketson and ETB Smith Work *Supporting the Development of an Underground Launching System for Blue Streak*, RPE Technical Note 170, Ministry of Supply.

[6] Hill, *A Vertical Empire*, pp.83-5, p.200; Cocroft and Thomas *Cold War*, p.48.

[7] TNA:PRO: AVIA 92/20 Ground Shock Loading Structure at AWRE Foulness Ballistic Missile Design Launching Sites 8-9-1958-13-6-1960, Memo, ML/154/03 E42 Suffield Trials, Canada 2/5/60.

[8] *Flight*, 'Blue Streak helps Titan', *Flight*, Vol.79 (1961), 29 June, p.889.

The problem of the historical invisibility of the elements of the underground launching facility project destined for the Spadeadam Rocket Establishment have been compounded both by the abandonment of the system and the split responsibility between government organisations and a private company. The existence of this scheme was almost unknown to many of the former Rocket Establishment employees who were interviewed for the oral history project by staff from the Tullie House Museum and Art Gallery, Carlisle. One exception was Ron Lake, a former de Havilland Propellers employee, who was able to confirm that work had begun on the silo somewhere to the east of Greymare Hill at Whipper Slack. A number of factors may account for the lack of knowledge, including the compartmentalisation of activities - so, for example, the construction personnel would rarely mix with the establishment's employees. Also many of the interviewees arrived during the 1960s after Blue Streak had been abandoned as a missile project. Similarly Fred Pitt, the senior civil engineer on the site, knew of the work but no details.[9]

A note in a Royal Aircraft Establishment Blue Streak monthly report for June 1958 described the intended function of the U1 facility at Spadeadam. It was primarily to be used to investigate the conditions associated with firing a missile in an underground launching facility.[10] The first firings were planned for July 1960 in time to prove the design of trial launchers to be built in Australia and for the operational sites. It was suggested that U1 might be used for further missile or motor development work. One of the problems encountered with the test model at Westcott was that the intense heat from the rocket motor melted the concrete surface. Even with the use of special refractory concrete the prototype silo's lining would have required constant renewal if it was to remain in use for any length of time.[11]

A letter from the Ministry of Supply to the Treasury verifies that plans were well-advanced for the construction of an underground ground launching facility at Spadeadam by September 1958.[12] Trial bore holes had been drilled during the summer and permission was sought to begin the construction of a full size silo at a cost of £690, 000, plus a 15 per cent agency fee. Owing to the proximity of the bedrock to the surface

[9] Correspondence with Dr Francis Walley April 2005, formerly of the Ministry of Works

[10] Quoted in Dommett 1998 'Silos for Blue Streak', p.9.

[11] Correspondence with Dr Francis Walley April 2005.

[12] TNA:PRO: T225/1150 Blue Steak (medium range ballistic missile): test site Spadeadam 1956-59

and the great expense (and time) that would be incurred excavating a hole 150 ft (45.72m) deep, it was planned to dig a 30ft (9.14m) hole through the overburden down to the bedrock. The base of the silo would be placed in the hole while the remainder of the structure would be above ground. It was also proposed to place the missile silo hole close to the Greymare Hill Missile Test Area so that advantage could be taken of its technical infrastructure.

A contemporary air photograph taken in August 1961 confirms that work had begun on the silo (Figure 1). It shows an excavation with disturbed ground to its north and traces of heavy vehicle tracks leading westwards back towards the southern end of the Greymare Hill complex.[13] Following the cancellation of the missile project in April 1960, all major civil engineering work was halted, proving that this work had taken place prior to that date.

Figure 1. Greymare Hill to the bottom right is the start of the excavations for the trial underground launcher.
F21 J43 RAF/1429 Frame 149 August 1961 MoD © Crown copyright)

[13] English Heritage, National Monuments Record, air photograph F21 543RAF/1429 Frame 149, August 1961.

The excavations were somewhat curiously situated in the bottom of the valley of a small stream called the Cheese Burn, potentially causing the hole to flood. This location may probably be explained by the projected design for the silo model, whereby only about one-fifth would be below ground and the remainder would project above the surface (Figure 2). With such an arrangement the top of the silo would be approximately level with the top of the valley. This may have allowed a level causeway to be constructed from the crest of the valley to the top of the silo to allow the rocket to be manoeuvred into position. Similarly at Woomera, Australia, it was proposed to construct the test silo on the side of a ravine, again to reduce the need for unnecessary excavation, work on which had begun by March 1960.[14]

Subsequent to the abandonment of the project the silo trials area was covered by a dense coniferous plantation, effectively hiding the site from view for over forty years. The excavations were exposed again by recent tree felling and were surveyed during the 2004 English Heritage archaeological survey of the Rocket Establishment (Figure 2).[15] Ground works associated with the tree planting had removed any trace of the tracks visible on air photographs leading from Greymare Hill to the excavation. No coniferous trees were planted in the immediate vicinity of the test hole and the area is covered by short grass and recently planted deciduous trees. To the west of the hole a by-pass channel was begun to divert the Cheese Burn around the excavation. At its western end are the remains of a sluice comprising two concrete walls into which are set two vertical 2 x 4-inch (5 x 10 cm) steel channels into which blocking boards could be inserted into the 2.99m wide gap. Beyond the sluice an earthwork channel may be traced along the southern valley scarp and to the south of the hole. To the north of this sluice the original line of the stream was straightened and its sides lined with rocks, some cemented into place. The base of the stream is very hard and may have been surfaced in asphalt. Close to the hole is another sluice constructed in a similar manner to the one described above, although here the gap is 3.06m. The excavated hole is roughly circular in shape and measures about 32m in diameter, the northern side of the hole has a well-formed curved plan and a good profile. Around the lip of the hole, close to where the stream enters, are traces of concrete blocks that were used to line the excavation. Running approximately north to south across the centre of the hole are three rows of boards; the boards measure 1ft 2in x 2in (34cm

[14] Hill, *A Vertical Empire*, p.89: Martin, *De Havilland*, p.144.

[15] Catherine Tuck and Wayne D Cocroft, *Spadeadam Rocket Establishment, Cumbria*, AI/20 2004 (English Heritage: Swindon, 2004).

x 5cm) and are fixed to vertical posts 3 3/4-in (9cm) square. They are joined together with well-finished lap joints and bolts and are further strengthened by U-shaped cleats hammered between the joints (Figure 3). They probably represent shuttering put in place to support the sides of the hole during excavation. To the north of the hole are a series of spoil mounds up to 2m in height.

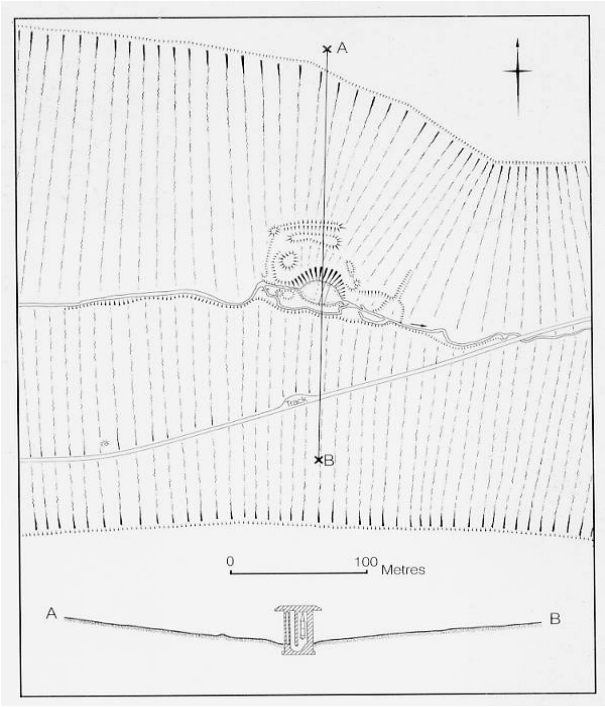

Figure 2. Plan of the excavations for the trial underground launcher, the profile shows how the launcher might have sat in regards to the local topography.

Figure 3. The remains of the excavations.

Although the United Kingdom never adopted the underground launching facility the United States took a keen interest in the design work. Colonel Leonhardt, Deputy Commander for Installations, Ballistic Missile Installations, came to England to assess the work. This resulted in the construction of a one-sixth scale model in the United States similar to the one built at Westcott.[16] In May 1961, *Flight* magazine reported on the development of a silo for the Titan II Intercontinental Ballistic Missile, revealing a month later the assistance the Martin Aircraft Company, Denver, had received from de Havilland Propeller engineers.[17] Research by BROHP has also revealed the involvement of Dr Barrie W A Ricketson, Head of Gas Dynamics at the Rocket Propulsion Establishment, Westcott, in the transfer of this technology when he recounted a visit to the United States to brief the Americans on the progress of work in the United Kingdom. A historian of the Titan project

[16] Hill, *A Vertical Empire*, p.85.

[17] Iain Pike, 'In-Silo Launch', *Flight*, Vol.79 (1961), 25 May, 688-9; *Flight*, 'Blue Streak helps Titan', p.889.

summed up the significance of the British design work when he commented that 'Blue Streak was the free world's first in-silo launch weapon system concept' - Titan II missile silos remained in operational service until 1987.[18]

[18] David K Stumpf, *Titan II: a History of a Cold War Missile Program*, (Department of Arkansas Heritage: USA, 2000), p.26; Hill, *A Vertical Empire*, p.85.