5 METHODOLOGY

5.1 Rope access methodologies – industrial rope access

Industrial Rope Access is a system of access derived from rock-climbing and caving techniques, which have been adapted to suit industrial situations. Used extensively first on North Sea oil platforms, rope access has spread rapidly across many sectors of industry and throughout the world. Central to its continuing safety has been the formation of IRATA, the Industrial Rope Access Trade Association, a collective of rope access companies in the UK who standardised training and working procedures before any formal legislation. In training, a three-level system was introduced, where a technician's responsibility increases with his or her knowledge and experience of rope access. A level 1 standard is the basic level, in which a technician can use all rope techniques and equipment safely but does not set up the equipment or bear full responsibility for others' safety, which is the role of the level-3 operative. Two examples of the types of working procedure introduced by IRATA are that every attachment has a back-up (and hence every person is attached to two ropes at all times), and that no one should access an area where they cannot be retrieved by the rest of the team, whether conscious or not.

IRATA has an unrivalled safety record for working at height: there have been no working-at-height fatalities in IRATA companies since IRATA records began in 1989, and greatly reduced incident statistics in general (see www.irata.org or www.hse.gov.uk/research/rrpdf/rr116.pdf).

Many of IRATA's tenets are now enforced by law, in the British standards and Working at Height Regulations. This legislation means that it is now illegal to use less safety-conscious practices (such as those used in sport climbing or caving) for professional purposes.

The rope access methods and equipment used in the STAC project adhere to the Working at Height Regulations (WAHR 2005) and the British Standards (BS 8437: 2005) as well as satisfying the procedures and guidelines of the Industrial Rope Access Trade Association (IRATA). All equipment used had the relevant European Norm (EN) and CE marks. All STAC personnel were trained to IRATA level 1 standard, and were under the supervision of an IRATA level 3 supervisor, at all times.

5.2 Rope access and the STAC project

Specific access procedures are outlined for each site in the relevant sections of this report. In general, however, access routes for both the landward and the stack cliffs were selected by taking into account a variety of factors, most importantly the security of rock faces above the route, in case of rock fall, and the opportunity for safely fixing ropes. For this reason in some cases an apparently easy approach to the foreshore may not have been used (see Dun Arnistean access discussion, Section 10.3).

The anchoring of ropes in such isolated places was an issue that had to be resolved, and a number of different solutions were used or developed to suit the occasion. The simplest was to drive 1.5m-long stakes of angle-iron into the ground which were pointed at one end and provided with a hole to clip into at the other. Although very safe, this technique was not ideal for use in archaeologically sensitive areas. Also, the original versions were made from mild steel, which made them very heavy to carry across the moors, especially if using a sledgehammer to drive them in. Aluminium alloy versions were made, which could be driven in with rocks used as hammers found at each site. This technique was most often used on the mainland side of access routes, beyond areas of potential archaeology.

One of the safest ways of anchoring a rope to a rock face is through the use of bolts, stainless steel expansion bolts that lock into pre-drilled holes in the rock. Although these are very versatile and can be used anywhere with solid rock, the technique has the drawback of requiring heavy or inconvenient equipment including a large battery-powered hammer drill, the bolts themselves and an adjustable spanner for installation. Another semi-permanent solution was to use 'pitons' or 'pegs'; variously shaped pieces of metal driven into cracks in the rock using a specialised hammer. These also have the drawback of being heavy and potentially awkward. Nevertheless bolts and pegs were used in many cases on the stacks or islands due to over-riding safety considerations. Every effort was made to avoid leaving the remains of such equipment on the stacks.

In addition to the above, 'natural protection' was also used, ie various pieces or devices of metal designed to wedge into natural cracks or shapes in the rock, or slings looped over rock protrusions, and removed as the climbing continued. A variety of this type of equipment was used, including rp's, nuts, hexes, cams and friends.

5.3 Topographic survey methods

A Leica Electronic Total Station was used for the stack surveys. All data was logged using PENMAP

4.34b Series 1000:600 software (Strata Software and Consultancy Ltd), and a hand-held Strata field computer.

More than two survey stations were required at many sites in order to attain complete coverage of hidden and seaward slopes. In addition to the archaeological features recorded as strings, a *c* 1m interval or less coverage of spot heights was recorded to allow the creation of a topographical model of the surface of each stack. These surfaces were defined as the area bounded by steep or vertical cliffs. Access routes were also surveyed. The high tide line was clearly visible at all the sites and was therefore used as an approximation for sea level, at Mean High Water Spring. The landward footprint of each site was accurately surveyed. However, the shape of the seaward side of each stack was usually reconstructed from photographs, due to time and safety considerations in all cases except Caisteal a' Mhorair and Dun Othail. Each survey was then tied into fence-lines, summits or other mapped features.

5.4 Field methodology

Once each site had been accessed successfully, a description and measured sketch drawing of all the archaeological structures was undertaken, with notes and photographs taken. The top of the stack was then mapped and any archaeological structures were outlined using the digital survey equipment. Progress was often slow, as each team member was required to be attached to a fixed rope at all times on the summit of each stack.