(57) Abrégé/Abstract:
Described is a device (410) for use in removing a conveyance member from a material. The device (410) includes a displacement element (412) for being placed at least partly around a conveyance member and for displacing material as the device is advanced.
(57) **Abstract (continued):**
along a conveyance member. The device (410) also includes a driven component for receiving a driving force for driving the device through material. The device can include a coupling element (418) for coupling the device to a shaft and a material loosener (414) including a drilling element. The material loosener can be operable to loosen material ahead of the displacement element as the device is advanced along a conveyance member. The drilling element can be coupled to a first wheel (436) and the coupling element can include a second wheel (434) cooperating with the first wheel to transfer rotational movement of a shaft to the drilling element.
Title: CONVEYANCE MEMBER REMOVAL METHOD AND DEVICE

Abstract: Described is a device (410) for use in removing a conveyance member from a material. The device (410) includes a displacement element (412) for being placed at least partly around a conveyance member and for displacing material as the device is advanced along a conveyance member. The device (410) also includes a driven component for receiving a driving force for driving the device through material. The device can include a coupling element (418) for coupling the device to a shaft and a material loosener (414) including a drilling element. The material loosener can be operable to loosen material ahead of the displacement element as the device is advanced along a conveyance member. The drilling element can be coupled to a first wheel (436) and the coupling element can include a second wheel (434) cooperating with the first wheel to transfer rotational movement of a shaft to the drilling element.
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CONVEYANCE MEMBER REMOVAL METHOD AND DEVICE

Technical Field

5 The present invention relates to methods for removing conveyance members and devices for use in removing conveyance members.

Background

10 In the United Kingdom and around the world, significant lengths of electrical cable are underground, especially in built-up areas where it is difficult or undesirable to suspend cables from pylons.

In many cases, since these cables were laid, further building has been done above the cables.

At present, in order to remove such cables, it is generally necessary to dig them out. However, this is often extremely difficult, for example where extensive building has been carried out above them and/or where the owner of the land does not wish his land to be disturbed. For example, if the cables pass under farmland, it is often necessary initially to remove and store the topsoil. Then it is necessary to dig out the cable. Once the cable has been dug out, it is necessary to import earth to fill the void left by the removed cable, before replacing the topsoil. Throughout this procedure, the farmer is unable to use his land.

As a result of these difficulties, it is often easier to leave redundant cables where they are.

However, many underground electricity cables include oil under pressure to prevent the high-voltage conductive core becoming inadvertently grounded. This can be an environmental risk since the oil can be environmentally damaging if it
leaks. Furthermore, the risk of such leaks is higher with redundant cables since they are generally older and potentially degraded in comparison with newer cables.

One way in which this risk is addressed is by soldering caps onto the ends of sections of redundant cables to prevent leakage of oil. However, this is a costly process and needs to be carried out by an expert jointer.

GB 2466897, GB2431424 and GB2426534 disclose overdrilling devices. DE19802691 and DE19504484 disclose equipment for removing buried cables. Energy Networks Association NIA Project Registration and PEA Document of February 2014 provides details of a project for cable extraction.

Summary of the Invention

Aspects of the present invention seek to provide an improved conveyance member removal method and device.

According to an aspect of the invention, there is provided a device for use in removing a conveyance member from a material, including:

- a coupling element for coupling the device to a shaft;
- a displacement element for being placed at least partly around a conveyance member and for displacing material as the device is advanced along a conveyance member;

- a driven component for receiving a driving force for driving the device through material; and
- a material loosener operable to loosen material ahead of the displacement element as the device is advanced along a conveyance member;

wherein the material loosener includes a drilling element coupled to a first wheel and the coupling element includes a second wheel cooperating with the first wheel to transfer rotational movement of a shaft to the drilling element.
A difficulty faced by many prior art drilling devices is how to provide a rotational drilling movement to a drilling element. This difficulty can be exacerbated by the fact that the axis of the drilling element is generally parallel to but laterally displaced from the axis of a shaft coupling the device to a driving unit.

Preferred embodiments of the invention are able to laterally transfer rotational movement from a shaft to a drilling element using a dual wheel system, thereby effectively enabling a driving unit to remotely control and drive rotation of the drilling element.

According to an aspect of the invention, there is provided a device for use in removing a conveyance member from a material, including:

- a displacement element for being placed at least partly around a conveyance member and for displacing material as the device is advanced along a conveyance member; and
- a material loosener operable to loosen material ahead of the displacement element as the device is advanced along a conveyance member.

According to an aspect of the invention, there is provided a device for use in removing a conveyance member from a material, including:

- a displacement element for being placed at least partly around a conveyance member and for displacing material as the device is advanced along a conveyance member; and
- a driven component for receiving a driving force for driving the device through material.

Preferably the device includes a material loosener operable to loosen material ahead of the displacement element as the device is advanced along a conveyance member.
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The term ‘ahead’ is intended to mean ahead in a direction along which the device is designed to be advanced and the terms ‘forwards’, ‘front’ and ‘back’ are similarly intended to be with respect to the direction in which the device is designed to be advanced.

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The term ‘conveyance member’ is intended to refer to for example elongate and/or tubular members or lines for conveying substances or signals, such as water, gas, electricity, or fibre optic signals, in particular underground. These can be for example wires, ducts or pipes, for example metal and/or plastic pipes. Preferably, the conveyance member is a cable, preferably an electricity cable. Nevertheless, although the term ‘cable’ is used throughout this description, embodiments can be used with other conveyance members or conveyance lines.

Preferred embodiments of the invention are able to loosen a cable in material, such as in the ground, sufficiently that it can be pulled or pushed in a longitudinal direction to slide out and be removed from the material. The device can be said to form a void around the cable or debond the cable from the material. This can mean that it is only necessary to excavate a small section of the cable, either an end or a section in which the cable can be cut to create an end, and the cable can be slid out from under the ground. This means that it is not necessary to dig a trench as long as the section of cable it is desired to remove, thereby saving significant time and expense.

Some previous attempts to remove cables in a longitudinal manner have resulted in the cable snapping, meaning that in order to recover the entire cable, it has been necessary to dig a long trench in the conventional manner. Furthermore, a snapping cable can lead to environmental risks if there is still oil in the cable. However, by providing a device which can travel along the cable and loosen material around the cable, the risk of the friction being greater than a breaking strength of the cable is minimised. In addition, the displacement element can displace the loose material away from the cable, compacting it outside the
circumference of the displacement element. This can create a void between the material and the cable, further decreasing the resistance to the removal of the cable.

Preferably, the displacement element is configured for substantially surrounding a conveyance member. Preferably, the displacement element or at least an inner edge thereof is substantially annular, and is configured to substantially surround a cable. Preferably, the displacement element is substantially circular in cross section. In other words, the displacement element can include a passageway therethrough for receiving a cable, the passageway preferably being substantially circular in cross-section.

The device can be considered to have a longitudinal axis which coincides with a longitudinal axis of a cable when the device is placed on a cable. Preferably, the material loosener is arranged substantially evenly around the longitudinal axis to provide substantially even loosening of material around a cable. The material loosener can be provided in, on, or as part of the displacement element.

In some embodiments, the material loosener is operable to create a suspension, hydrate and/or break up the material. For example, the material loosener can include a spray for spraying fluid ahead of the displacement element. This can make the material create a suspension and thereby loosen the material, allowing it to be displaced by the displacement element. The fluid can be a liquid, advantageously a lubricating liquid. The most preferred example of liquid to be used is bentonite solution. Bentonite solution is known in the drilling industry. It is a natural clay mixed with water which can cause earth and rock to float. This is advantageous since it can stabilise the void created by the displacement element, cool the device, and lubricate the displacement element. It is possible to use other fluids. For example, emulsion slurry can be used. However, this is not preferred since it is not biodegradable.
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The material loosener can include a fluid distribution network including:

- an inlet for receiving fluid from a fluid source; and
- a plurality of forward-facing outlets for emitting fluid into material ahead of the displacement element, the plurality of outlets being coupled to the inlet by one or more conduits.

The inlet can be coupled to a fluid source via a feed conduit.

In some embodiments, the fluid distribution network includes a first distribution conduit for transporting fluid in a first angular direction around the longitudinal axis and a second fluid distribution conduit for transporting fluid in a second angular direction around the longitudinal axis opposite to the first angular direction. Each of the first and second distribution conduits can include a plurality of evenly spaced outlets. The first and second distribution conduits can be on or in the displacement element. The fluid distribution network can be housed within a housing for protection with openings for the outlets and inlet to emit and receive fluid, respectively. Part or all of the housing can be provided by the displacement element. The outlets can be configured to emit fluid through openings in the displacement element.

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The material loosener can include a drilling element.

The drilling element can include any features to assist drilling, such as teeth. The drilling element is preferably operable to perform complete and continuous rotation, in other words it can preferably rotate continuously in the same angular direction through at least 360°.

In some embodiments, the drilling element is provided at or on the front of the displacement element. However, in other embodiments, the drilling element can be an annular element distinct from the displacement element. If the drilling element is a distinct annular element, it preferably has a greater diameter than the
displacement element since the displacement element is designed to push out loosened material.

Preferably, the device, preferably the driven element, includes a coupling element for coupling the device to a shaft. A shaft coupled to the coupling element can apply a force to the driven element to drive the device through the material. The coupling element can include a longitudinal force transfer element to transfer a longitudinal force in the shaft into a longitudinal advancing force on the displacement element to advance the displacement element through material.

The coupling element can be configured to couple a shaft to the device to transfer longitudinal forces in the shaft to the displacement element, and rotational forces in the shaft to the material loosener. This can allow operation of the shaft to advance the device in a rotating manner, causing a drilling or boring action.

In some embodiments, the material loosener can be fixedly coupled to or integral with the displacement element so that the material loosener and the displacement element rotate together or as a single unit and the device advances as a single unit. In such embodiments, the device can include a stator with respect to which the material loosener and displacement element can rotate.

The material loosener can include a drilling element coupled to a first wheel, and the coupling element can include a second wheel cooperating with the first wheel to transfer rotational movement of a shaft to the drilling element. If the displacement element and material loosener are configured to rotate together, the first wheel can be provided in the displacement element.

A difficulty faced by many prior art drilling devices is how to provide a rotational drilling movement to a drilling element. This difficulty can be exacerbated by the fact that the axis of the drilling element is generally parallel to but laterally displaced from the axis of a shaft coupling the device to a driving unit.
Preferred embodiments of the invention are able to laterally transfer rotational movement from a shaft to a drilling element using a dual wheel system, thereby effectively enabling a driving unit to remotely control and drive rotation of the drilling element.

The coupling element may include one or more thrust bearing housings through which a shaft can rotatably pass and which can transfer longitudinal forces on the shaft into longitudinal forces on the device. The thrust bearing housings can be configured to transfer longitudinal forces to the stator, the stator being configured to transfer longitudinal forces to both of the material loosener and the displacement element.

Preferably, the first wheel is a sprocket and the second wheel includes a perforated track, preferably a chain of roller bearings. This advantageously allows loose material such as mud to be pushed out of the region of engagement of the first and second wheels by the sprockets of the first wheel pushing it through the perforations of the second wheel. This prevents the first and second wheels from becoming clogged which would otherwise be a risk since they are designed to operate surrounded by often solid material, for example underground.

Preferably, the axes of the first and second wheels are both substantially parallel, for example are both substantially longitudinal, so that the planes of rotation of the shaft, and the first and second wheels are all substantially parallel, providing an intuitive transfer of force from a shaft to the device.

Preferably, the axis of the first wheel is outside a circumference of the second wheel.

The material loosener can include a drilling element coupled to a plurality of first wheels, and the coupling element can include a plurality of second wheels, each
second wheel cooperating with a respective first wheel to transfer rotational movement of a shaft to the drilling element. If the displacement element and material loosener are configured to rotate together, the plurality of first wheels can be provided in the displacement element. Each of the first and second wheels can be as described above. Having a plurality of first and second wheels means that the components are less likely to snap and more power can be transferred to the drilling element.

In some embodiments, the material loosener can be fixedly coupled to or integral with the displacement element so that the entire device rotates and advances as a single unit. Where a drilling function is provided in these embodiments, it can be provided by oscillation of the entire device.

According to an aspect of the invention, there is provided a system for removing a cable from a material, including:

- a device as described above; and
- a driver for applying a forward force to the device.

Preferably, the driver includes a shaft coupled to the driven element of the device.

Preferably the driver includes a driving or drilling unit operable to apply a longitudinal force to the shaft.

Preferably the driver is operable to provide a rotating force to the device, preferably to the shaft, preferably to the material loosener.

In some embodiments, the driver is operable to supply a fluid, preferably under pressure, to the spray of the device. The fluid can be supplied for example using the shaft as a feed conduit.
According to an aspect of the invention, there is provided a device for securing a cable mover to a cable, including:

an annular clamp for being received around a cable, an internal diameter of a first end of the annular clamp being greater than an external diameter of a cable to be moved;

a coupling element for coupling the annular clamp to a cable mover; and at least one block for being pressed between the clamp and a cable; wherein the at least one block and/or the annular clamp includes a taper whereby a force on the clamp causes the clamp to press the block against the cable.

Preferably, the annular clamp has a taper and an internal diameter of a second end of the clamp is less than the internal diameter of the first end of the clamp.

Preferably, the block is a wedge.

Preferably, a surface, preferably a tapered surface, of the wedge includes a gripping finish, for example a roughened finish, to increase friction with the annular clamp.

According to an aspect of the invention, there is provided a method of moving a cable including:

placing an annular clamp over a cable, wherein an internal diameter of a first end of the annular clamp is greater than an external diameter of a cable to be moved;

placing at least one block between the clamp and the cable; and applying a force to the clamp in a direction in which the first end of the clamp is facing, to move the cable; wherein the at least one block and/or the annular clamp includes a taper whereby the force on the clamp causes the clamp to press the block against the cable.
Preferably, the force on the cable is longitudinal.

Preferably, the or each block is a wedge and the or each block is placed between the clamp and the cable with a thicker end of a taper of the wedge facing the direction in which the force is applied.

According to an aspect of the invention, there is provided a method of removing a cable from a material, the method including:

- placing a device as described above on the cable at or near a first end thereof;
- advancing the device towards a second end of the cable to loosen material adjacent to the cable between the first and second ends; and
- applying a substantially longitudinal force to the cable to draw the cable out of the material.

According to an aspect of the invention, there is provided a method of removing a cable from a material, the method including:

- loosening or displacing material adjacent to the cable; and
- applying a substantially longitudinal force to the cable to draw the cable out of the material.

Advancing the device preferably includes rotating or oscillating a material loosener of the device, for example to enable any material adjacent to the cable to be loosened.

Advancing the device can include applying fluid under pressure to the spray of the device, for example to the fluid distribution network, to cause the device to spray and thereby loosen material ahead of it.
Preferably, advancing the device includes advancing a shaft coupled to a driven element of the device.

Applying fluid to the device can include applying fluid via the shaft.

The method can include excavating material around the first end to allow the device to be placed onto the cable and to allow a cable mover to be attached to the cable to apply the longitudinal force.

The method can include excavating material around the second end.

The method can include excavating material around a first and/or a second section of cable and cutting the cable in that or those section(s) to form the first and/or second end.

Preferably, if a cable is cut to form an end, the method also includes capping the cable, preferably using the method for capping a cable described below.

Preferably, after the cable is removed, the method includes pumping a filling material into a void left by the cable.

In other embodiments, the method can include inserting a duct into a void left by the cable to keep the void open for possible reuse. This can be done by attaching a duct to the second end of the cable before the cable is withdrawn so that the cable draws the duct into the void as it is being withdrawn.

According to an aspect of the invention, there is provided a method of capping a cable, including:
- placing a cap over an end of a cable; and
- coupling the cap to the cable by a mechanical coupling only.
The cap is preferably secured to the cable by an interference fit.

The preferred method of securing a cap to a cable avoids the need to have the cap soldered to the cable. This avoids the time and expense of having an expert jointer soldering the cable.

Although the preferred method of capping a cable may allow some moisture into the cable, this is not a problem where the cable is not intended to be reused since the reason for excluding moisture is that it may provide a path to ground for electricity in a live wire. The inventors have discovered that a cap coupled by purely mechanical means is sufficient to prevent egress of oil, which is all that is necessary in redundant oil filled cables.

Brief Description of the Drawings

Preferred embodiments of the invention are described below, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a device according to an embodiment of the invention;

Figure 1A is a front view of the device of Figure 1;

Figure 2 is a perspective view of a device according to an embodiment of the invention;

Figure 2A is a perspective view of a wedge for use in the device of Figure 2;

Figure 2B is a schematic cross section of the device of Figure 2;
Figure 3A is a schematic cross section of an area of ground in which a cable is located;

Figures 3B to 3H are schematic cross sections of the area or a part of the area of ground of Figure 3A during operation of a method according to an embodiment of the invention;

Figure 4 is a schematic perspective view of a device according to an embodiment of the invention;

Figure 5 is a schematic side cut-away view of a device according to an embodiment of the invention;

Figure 5A is a schematic front view of a rotational force transfer element for the device of Figure 5;

Figure 5B is a front view of a longitudinal force transferring element;

Figure 6 is a schematic side cut-away view of a device according to an embodiment of the invention;

Figure 7 is a schematic side view of a device according to another embodiment of the invention; and

Figure 8 shows a cross section of a cap for an end of a cable in an embodiment of the invention.

Description of the Preferred Embodiments

As described above, electrical cables are often buried in the ground. There is a variety of materials which can be around the cable underground, such as earth,
soil, sand, cement, cement bound sand (CBS). Embodiments described below are generally described for a cable surrounded by soil. However, the description is equally applicable to a cable surrounded by other materials.

Particularly preferred embodiments include a drilling element and are able to address prior difficulties in how to provide a rotational drilling movement to a drilling element. However, for ease of description, these embodiments are described later.

As can be seen from Figure 1, a device 10 according to an embodiment of the invention includes a displacement element 12 and a material loosener 14.

The displacement element is an annular element arranged so that as it is advanced along a cable 16 it displaces soil that was adjacent to the cable 16, compacting the soil outside the outer perimeter of the displacement element 12.

The displacement element 12 and therefore the device 10 can be considered to have a longitudinal axis which when the device is placed on a cable corresponds to a longitudinal axis of the cable.

As can be seen from Figure 1, a cross section of the displacement element 12 when viewed along the longitudinal axis is substantially circular in order to correspond with the cable 16. In particular, a cross-section of an inner passageway is substantially circular to receive the cable and a cross-section of the outer perimeter is substantially circular for tunnelling efficiency.

A diameter of the displacement element is slightly greater than the diameter of the cable 16 on which the device is designed to be used. In the embodiment of Figure 1, the outer diameter of the displacement element is about 160mm. However, different cables have different diameters, and it is accordingly possible to provide a plurality of devices as described herein, each with a displacement element with a
diameter or at least an inner diameter of a different size, designed to fit different cables.

The device 10 includes a coupling element 18 for coupling the device to a shaft 20. The coupling element 18 can be a tube for securely receiving a shaft, for example by an interference fit. The shaft is thereby able to provide longitudinal and rotational force to the device 10. As described below, the shaft is also able to provide fluid for the material loosener 14.

The material loosener 14 in this embodiment includes a fluid distribution network providing a spray. The fluid distribution network includes an inlet 22 in the coupling element for coupling to and receiving fluid from the shaft 22, the shaft acting as a feed conduit.

The inlet 22 includes a conduit inside the coupling element 18 which leads fluid from the shaft to a fluid junction 24. The fluid junction 24 is arranged to divide fluid and includes first, second and third output conduits. The first conduit 26 passes inside and around the displacement element 12 in a clockwise direction adjacent to a front edge of the displacement element 12. The first conduit leads fluid around the displacement element 12 in a clockwise direction. Evenly spaced along the first conduit are provided apertures 30 in the conduit and displacement element 12 through which fluid in the first conduit is emitted forwards.

The second conduit corresponds to the first conduit except that it passes around the displacement element 12 in an anti-clockwise direction.

The first and second conduits terminate adjacent to each other at a point substantially diametrically opposite the junction 24. However, they are not in fluid communication at this point.
The third conduit 28 leads longitudinally forwards from the junction 24 and terminates in a further aperture 30 in line with the shaft 20.

However, in other embodiments, different configurations of the fluid distribution network are possible. For example, it is not always necessary to have the third conduit 28. Furthermore, it is possible to have a single conduit which passes all the way around the displacement element 12 from the junction 24 rather than having two conduits passing in opposing directions. It is also possible for each aperture to have its own dedicated conduit leading from the junction 24.

Additionally, it is not necessary to have the apertures 30 evenly spaced. However, having two opposing conduits has been found to be an efficient way to provide a symmetrical pressure of fluid emission from a single feed conduit.

Figure 2 shows a device 100 for securing a cable puller to a cable 16. The device 100 includes an annular clamp 102 which can be received on a cable 16.

As can be seen more clearly in Figure 2B, the annular clamp includes a first internal diameter 104 at a first end 106 and a second internal diameter 108 at a second end 110. The internal diameter is the diameter of the cross section viewed along a longitudinal direction inside the clamp, in other words the space through which a cable can pass.

The first internal diameter 104 is greater than the second internal diameter 108 and the internal surface of the annular clamp tapers from the first end to the second end.

The device includes a plurality of removable wedges 112. The wedges are blocks with a tapering surface 114. The taper of the tapering surface 114 corresponds to the taper of the annular clamp so that the wedges 112 can fit between the internal surface of the annular clamp and the cable while being in substantially full contact with both.
The tapered surface 114 of the wedges 112 is provided with a roughened gripping finish to increase friction with the clamp.

As can be seen from Figure 2, in this embodiment there are four wedges 112 for being placed between the clamp and a cable. However, there can be more or fewer than four in other embodiments.

The device 100 includes a plurality of coupling elements 116 attached to the clamp for coupling to a cable puller. As shown, these can be in the form of loops. They are preferably located symmetrically about the annular clamp in order to provide a substantially longitudinal force to the device 100. In the embodiment of Figure 2, the coupling elements 116 are located in a line with the clamp, with one either side of the clamp.

The devices 10 and 100 described above can be used in a method of removing a cable as follows.

As shown in Figure 3A, an area of ground is located in which a cable 16 passes under the ground.

As shown in Figure 3B, a first excavation is made to excavate a launch site 200 exposing a first section of the cable 16, and a second excavation is made to excavate a receive site 220 exposing a second section of the cable 16.

As shown in Figure 3C, the first and second sections of cable are cut to create a section of cable to be removed with a first end 222 and a second end 224.

As shown in Figure 3D, each of the exposed ends of cable have a cap secured to them by purely mechanical means. The caps 226 are generally available for sale as caps for gas or water pipes. Previously, it has been considered necessary to
solder copper caps to the ends of electric cables, especially oil filled electric cables, to keep out moisture. However, this is expensive. While soldering copper caps can still be done if the cable is to be reused, for redundant cables, it is advantageous to secure a cap by purely mechanical means. A cross section of the cap 226 on the end of the cable is shown in more detail in Figure 8. As can be seen from Figure 8, a cap end 225 is an open-ended cylinder configured to fit over the end of the cable. The cap end 225 includes a rubber annular wedge 227 which tapers from a first larger inner diameter nearer the open end of the cap end to a second smaller inner diameter nearer the closed end of the cap end. As a cable is pushed into the wedge, an interference fit is formed between the wedge and the cable to hold the cable.

The next stage is to loosen material adjacent to the cable 16 for the section that is to be removed.

A first end of a shaft 20 is coupled to a device 10 as described above. A second end of the shaft 20 is coupled to a horizontal directional drilling unit 230. Horizontal directional drilling units 230 are well known in the drilling sector.

The device 10 is placed over the first end 222 of the cable 16 so that the cable passes through the annulus of the displacement element 12.

The drilling unit 230 is operated to supply liquid, in this example in the form of bentonite solution, through the shaft 20 under pressure.

The liquid enters the inlet 18 of the device 10 and is distributed by the junction 24 to the first, second and third conduits. Owing to the pressure of the liquid, the liquid sprays out of the apertures 30 in a forward direction with respect to the device 10.
The horizontal directional drilling unit 230 is operated to apply a longitudinal force to the shaft 20 and thereby advances the device. The drilling unit 230 can also apply a rotational force to the shaft to cause the device 10 to oscillate as it is advanced. While this can advantageously make the loosening of the material more efficient and symmetric, it is not always necessary.

As the device 10 is advanced into the soil, the liquid is being sprayed in front of the device, causing the soil to become a loose suspension. As the displacement element is advanced into this loose suspension of soil, it easily pushes it away from the cable 16 and compacts it outside the perimeter of the displacement element 12. This creates a void immediately around the cable 16.

Often, the shaft will be made up of a plurality of shaft sections. In this case, the drilling unit 230 is operable to couple the shaft sections together to lengthen the shaft as it is being advanced, in a manner known in the art.

Once the device 10 has emerged in the receive pit 220, the device 10 is decoupled from the shaft 20 and removed. However, the shaft is left in position.

The shaft 20 is then decoupled from the drilling unit 230 and a device 100 as described above is attached to the cable 16 near the first end 222 as shown in Figure 3F.

The device 100 is placed over the first end of the cable and advanced over the cable so that the first end 106 of the device 100 faces the direction in which the cable is to be withdrawn.

The wedges are then placed between the internal surface of the clamp 102 and the cable 16, and the coupling elements 116 are coupled to the drilling unit 230, which now serves as a cable remover, for example by cables 240.
The cable remover 230 is then operated to apply a longitudinal force to the device 100 in the direction from the second end 110 of the device 100 towards the first end 106.

The grip of the device 100 on the cable 16 causes this longitudinal force to be transferred to the cable and to draw the cable out of the soil towards the cable remover 230.

As the clamp 102 is pulled by the cable remover, the cooperation of the tapers of the wedges and the internal surface of the clamp causes the clamp to press the wedges tighter against the cable, thereby increasing the grip of the device on the cable. This minimises the ability of the clamp to slide along the cable.

Owing to the looseness of the soil where the device 10 has travelled along the cable and/or to the void created by the device, the cable 16 slides out of the soil in response to being pulled by the device 100.

In some embodiments, it is possible to attach a duct to the second end of the cable 16 so that as the cable is removed, it draws the duct in to replace the cable, thereby keeping the void open for possible future reuse.

However, in the depicted embodiment, once the cable has been removed, the shaft 20 is recoupled to the drilling unit 230 and the drilling unit is operated to retract the shaft 20 while spraying a grout 250 into the void left by the cable as shown in Figure 3G.

After about 6 hours, the grout will have set, thereby securely filling the void as shown in Figure 3H.

The method described herein can provide an inexpensive and rapid way to remove underground cables, with minimal disruption to the surface.
methods can remove a 150m section of cable, which would normally take about 2 weeks to remove, in about 90 minutes.

In addition to the above, various modifications can be made and different embodiments are possible.

Although the displacement element 12 is generally described as being annular, it is not necessary in all embodiments for the displacement element 12 to be continuous around the cable. However, it is preferred that the displacement element 12 is configured to displace material from the entire periphery of the cable. It is also not necessary that the displacement element 12 is circular in cross section when viewed along the longitudinal axis. However, it is preferred that the cross section when viewed along the longitudinal axis substantially corresponds to the cross section of the cable 16 when viewed along the longitudinal axis as this tends to maximise the material displacement efficiency of the displacement element.

Figure 4 shows another embodiment of a device for use in removing a cable corresponding in many respects to the device 10 of Figure 1. However, in the device of Figure 4, the aperture 30 at the end of the third conduit is provided in a nozzle 310.

Figure 5 is a schematic side view of another embodiment of a device 410 for use in removing a cable.

The device 410 includes a displacement element 412 and a material loosener 414.

As for the embodiment of Figure 1, the displacement element 412 is an annular element arranged so that as it is advanced along a cable 16 it displaces soil that was adjacent to the cable 16, compacting the soil outside the outer perimeter of the displacement element 412.
As for the embodiment of Figure 1, a cross section of the displacement element 412 when viewed along the longitudinal axis is substantially circular in order to correspond with the cable 16 and a diameter of the displacement element is slightly greater than the diameter of the cable 16 on which the device is designed to be used.

As for the embodiment of Figure 1, the device 410 includes a coupling element 418 for coupling the device to a shaft 20. The shaft is thereby able to provide longitudinal and rotational force to the device 10.

The material loosener 414 in this embodiment includes a drilling element 415. The drilling element 415 in this embodiment is a plurality of teeth projecting from a front of the displacement element 412. The teeth can be integral with or fixedly coupled to the displacement element.

In this embodiment, the displacement element 412 is rotatable through 360° about the longitudinal axis. Rotation of the displacement element 412 causes a corresponding rotation of the drilling element 415.

In this embodiment, there is provided a stator 417 with respect to which the displacement element 412 and drilling element 415 rotate. The stator 417 is annular, preferably cylindrical, and is configured for a cable to pass through it.

The stator 417 has a smaller diameter than the displacement element 412 and is partly inside the displacement element. However, in other embodiments, the stator 417 can have a larger diameter than the displacement element.

The displacement element 412 is rotatably coupled to the stator 417, but in a manner which allows longitudinal force to be transferred from the stator to the displacement element 412. In the depicted embodiment, this is by providing an
internal circumference of the displacement element with first and second circumferential channels 424, and providing the stator with corresponding projections 426 on its outer surface, in this embodiment in the form of brass wear rings, which allow the channels to rotate but not to move longitudinally with respect to the projections. A cross sectional view of the stator showing the projections, and a cable within the stator can be seen in Figure 5B.

However, there are various other means known to one skilled in the art for coupling a rotator to a stator so that rotational relative movement is permitted but longitudinal relative movement is inhibited. For example the channels and projections can be the other way around, with the channels on the rotating displacement element and the projections on the stator, and there can be more or fewer than two channels.

In this embodiment, the coupling element 418 is rotatable with respect to the stator 417. The coupling element 418 passes through a thrust box 428 which is fixedly coupled to the stator 417 and which allows the coupling element 418 to rotate with respect to it, but restricts longitudinal movement, thereby transferring longitudinal forces from the coupling element to the stator 417. As can be seen from Figure 5, in this embodiment this is achieved by providing ridges on the coupling element 418 which abut thrust bearings 432 when they try to move longitudinally. The thrust bearings are coupled to the thrust box to transfer longitudinal forces thereto.

However, there are various other means known to one skilled in the art for coupling a rotating shaft to a stator so that rotation of the rotating shaft is permitted but longitudinal relative movement is inhibited.

A sprocket 434 is coupled to the coupling element 418. The sprocket is arranged to rotate in a plane perpendicular to the longitudinal axis. The sprocket is arranged to cooperate with a perforated track 436 on or in the displacement element 412. The perforated track is circumferential on or in the displacement element and the
axis of the sprocket is outside the circumference of the displacement element. The cooperation of the sprocket and track is shown more clearly in Figure 5A.

As shown in Figure 5A, the teeth of the sprocket are configured to press into perforations 438 in the track, thereby forcing soil or other material out to prevent the system becoming clogged as it is drilling. The perforated track in this embodiment is provided by a chain of roller bearing needles. However, other forms of chain or perforated track can be used in other embodiments. Alternatively, gears can be used, although these are not preferred since they are at risk of becoming clogged.

Where the perforated track is provided on the displacement element, the displacement element is preferably provided with holes corresponding to and aligning with the perforations in the track to allow soil or other material to be pushed through the displacement element by the teeth of the sprocket. Where the perforated track is provided in the displacement element, the perforations preferably pass all the way through the displacement element to allow soil or other material to be pushed through the displacement element.

As can be seen in Figure 5A, the sprocket 434 is configured to leave a gap 435 between the track and the troughs 439 of the sprocket as those troughs pass over the track, the troughs being between two adjacent teeth of the sprocket. In this embodiment, the needle rollers 437 and the troughs have different radii of curvature to prevent a needle roller completely filling a trough. In this embodiment, the trough has a radius of curvature less than a radius of curvature of the needle rollers. The gap 435 enables grit or dirt to be held in the gap until it can escape without jamming the device or forcing the device to crush the dirt or grit which may be difficult where the dirt or grit is hard.
The coupling of the shaft to the drilling element enables the drilling element to be rotated through a full rotation. It also enables an efficient transfer of rotational force from the shaft to the drilling element.

The embodiment of Figure 5 can also optionally be provided with a fluid distribution network as described in connection with Figure 1.

The device of Figure 5 is operated in a similar way to the device of Figure 1 during removal of a cable. However, the device of Figure 5 is particularly useful for hard materials such as cement bound sand where significant drilling is required.

As the drilling unit 230 described above advances the shaft 20 which is coupled into the coupling element 418, it also rotates the shaft 20 preferably continuously in the same angular direction. This causes rotation of the coupling element 418, which in turn causes rotation of the sprocket 434.

The cooperation of the sprocket 434 and track 436 means that the sprocket 434 causes rotation of the displacement element 412 with respect to the stator 417.

The rotation of the displacement element 412 with respect to the stator 417 causes rotation of the drilling element 415 with respect to the stator 417, preferably continuously in the same angular direction, causing the drilling element to provide a drilling action on material in front of it, thereby loosening the material.

Longitudinal forces applied to the shaft are transferred to all components of the device thereby advancing the device through the material and causing the displacement element to displace the material as described above.

As explained above, a difficulty in drilling devices has been in transferring rotational motion of a shaft to a drilling element the axis of which is laterally offset. The embodiment of Figure 5 is able to transfer rotational motion of a shaft to
rotational motion of the drilling element. Furthermore, it is able to do this without the mechanism for transferring the rotational movement becoming clogged with the loosened material.

Figure 6 is a schematic cut-away view of a device according to another embodiment of the invention. The device corresponds in many respects to the device of Figures 5 and 5A, except that the stator has a tapering back.

Figure 7 is a schematic side view of a device according to another embodiment of the invention. The device of Figure 7 is similar in many ways to the device of Figure 5 except that in the embodiment of Figure 7 there are provided a plurality of adjacent perforated tracks 536 instead of the single perforated track 436 shown in Figure 5. In this embodiment, there are provided first, second and third perforated tracks 536, although other numbers of perforated tracks can be provided in other embodiments. Furthermore, instead of a single sprocket 434 as in Figure 5, there is provided a plurality of sprockets 534, each sprocket being coupled to a respective perforated track in the manner described in respect of Figure 5. An advantage of having a plurality of tracks and sprockets in this manner is that greater rotational power can be provided to the displacement element, and the likelihood of the sprocket and track becoming decoupled or a component snapping is reduced.

With regard to the method of removing a cable, it is not necessary to cut the cables if ends of cables can be located. Cables are generally provided in 300m sections. It is preferable to remove sections of 150m, thereby cutting each cable section substantially in two. However, different lengths of cable can be removed if appropriate and/or desired.

Furthermore, although the cable is described as being pulled from the launch site, it is equally possible to pull it from the receive pit.
Additionally, if the cable does not need cutting to form the second end, it is not always necessary to excavate a receive pit.

Further details of embodiments of the invention are included in the attached annexes 1 to 4.

All optional and preferred features and modifications of the described embodiments are usable in all aspects of the invention taught herein. Furthermore, all optional and preferred features and modifications of the described embodiments are combinable and interchangeable with one another.

The disclosures in British patent application numbers 1408164.0 and 1422808.4, from which this application claims priority, and in the abstract accompanying this application are incorporated herein by reference.
Annex 1
COVER LETTER

JSM GROUP
Sterling House
Mutton Lane
Potters Bar
EN6 3AR

CLIENT
Address
XXX
XXX
XXX

For the Att. of: XXX

Dear Sir,

Re: 

XXXSubjectXXX

Assuring you of our commitment at all times.

Yours faithfully

Mark Smith
Head of Marketing and Business Development
DOCUMENT INDEX

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APPENDICES

Appendix A Cost comparison models

Appendix B Carbon comparison models
1.0 Introduction

JSM are presenting the enclosed business case for non-intrusive cable extraction (NICE) which is offered as an alternative to traditional underground cable removal methods.

JSM have undertaken research and subsequent trials to establish the method and tools to facilitate non-intrusive underground cable extraction works effectively. Studies have been carried out to investigate the associated cost savings, reduced environmental impact, and the viability of value return of recovered commodities.
2.0 Background

So why remove decommissioned and redundant cables from underground? There are a number of delicate and sensitive underlying issues relating to redundant OFC's:

- Redundant cables, oil tanks and joints at risk of leaching insulating oils into the environment
- Threat of prosecutions and fines under the environmental act
- Corporate responsibilities to uphold, public charter pledges to sustainability
- Risk of 3rd parties damaging assets and then not reporting such incidents to National Grid
- Costly wayleaves and easement lease agreement requirements, and subsequent future term renewal costs
- The requirement of cable route section removals due to land sales to housing developers etc.
3.0 Benefits

Physical, environmental and commercial benefits:

3.1 Physical
- Substantially less excavating required, approximately 80% - 90% less
- Reduces Health & Safety risks
- Substantially less muck away and backfill materials being transported to and from site, less landfill dumping
- Reduced risk of damaging 3rd party utility services compared to conventional open cut trench
- Clean controlled process to prevent leached oil loss into the environment. Cable ends are capped at both ends in a controlled manner before being extracted
- Less intrusive excavations and disruptive impact to traffic flows and society in general, ie: (dust/noise/machine movements/ open trenches/fallen barriers/traffic management complications
- Less excavating = Less risks = Greater safety = increased positive public perceptions

3.2 Environmental
- Reduction in Carbon emissions using this process (Infrastructure Carbon Review Nov 2013)
- Contributes to the reduction of overall Whole Life Carbon (WLC) of the asset
- Substantially less noise, pollutants and residential annoyances
- Controlled cable oil management, no spills or contamination during removal
- 100% recycling of all cable components, no waste goes to landfill
- Environmentally sustainable process with minimal impacts to the environment
- Minimal impacts to ecological/conservation sensitive sites.

3.3 Commercial
- Less time spent in one location on highway minimising permitting costs/lane rentals/parking bay suspensions etc.
- Substantially less overall expenditure.
- Savings on wayleaves and land easement charges
- Opportunity to reuse cable void to insert a valuable duct for future use or sale
4.0 Method comparisons

4.1 Open cut in the Highway:

- Open cut excavation in the highway will take at least 5 times longer than the NICE method plus the expense of muck away to landfill and imported backfill. In addition to this there are reinstatement costs and extra traffic management /public segregation etc.
- Security of the asset costs during all open cut removal operations needs careful consideration
- Location of and protection to transversing services needs serious consideration when open cutting
- Estimate 15-20 days to complete 100m of open cut cable circuit removal in highway.

4.2 Open cut in Fields:

- Land Agents will normally insist on top soil/growing medium removal and stored on cleared ground to avoid contamination
- Same with sub soils to be reused as backfill
- Open trench will need to be either shored or battered, likely to be the latter which means double the volume of digging and muck storage etc.
- Operatives need to get in the trench to cut and cap the cable over a drip tray every 5m as oils will still leech out even after purging
- Will a haul road be required to pick up cables and transport to the sealed skip?
- Where will the muck be stored? Trench top width will be approx 4.2m wide if battered
A working easement width of a least 10m will be required to allow for all plant movements/safe site access etc.
- The backfilling process will take three times as long as it took to dig if it's done correctly (compacting in 250mm layers etc) and weather permitting
- Topsoil layer will need to be powered harrowed /seeded to meet farmers spec.
- Estimate 12 to 15 days to complete these works for 100m cable circuit removal in field.
4.3 **NICE method in highway overwhelming benefits:**

- Minimal excavation required for launch and receive pits (3m x 2m) approximately every 100-150m.
- Services located and protected using vacuum excavation methods (micro surgery)
- Negligible muck away compared to open cut: 24m³ (2 x 20 ton lorry loads) per 100m of NICE cable trench v 240m³ (24 lorry journeys) muck away to landfill from 100m of open cut shored trench (1000% more muck away) 1 x 24ton grab lorry produces 0.0166 tonnes of CO₂e per average working day
- Minimal light plant required compared to open cut requirements. Less fuel used means more sustainable practise
- Less backfill required 24m³ per 100m v 240m³ (min 24 x 20ton lorry loads) from the quarry to open cut site. (1000% more backfill / 1000% less sustainable)
- NICE removal for 100m in highway should take no more than 7 days drilling v 15 – 20 days for open cut excavation and reinstatement. Trench size (1.2m W x 2m D x 100m L)
- NICE reinstatements will be completed in one day, works move on to the next section.

4.4 **NICE method in the field overwhelming benefits:**

- Negligible top soil removals
- No muck away, no sub soil removal
- Minimal easement /site footprint required every 150m. (4m x 12m)
- No haul roads required
- Minimal excavations required for launch and receive pits (3m x 2m ) approximately every 150m
- Minimal light plant required compared to open cut requirements. Less fuel usage means more sustainable practise
- Less labour required
- Estimate 5 -6 days for the NICE removal of 100m of cable section in field.
5.0 Methodology

The process for non-intrusive underground cable removal is detailed under four main headings, each identifying a phase of the procedure:

1. Site preparation
2. Drill – cable loosening
3. Cable pull

JSM have developed a cutting tool which will loosen the grip of the surrounding cable. This tool is attached to a directional drilling rig, fits around backfill to the cables and then to attach a substantial pulling device that would not require live winch cables or ropes on sites so close to the public interfaces.

Lots of ideas were 'desktop developed' and discussed before final prototype equipment was manufactured.

The equipment consists of a cable loosening drill head and a cable slip bowl with gripper collets. (as used in the oil drilling world)

Further improved prototypes are in development at this point in time.
5.1 Site preparation

5.1.1 Trial holes
Once the cable to be removed has been identified, various trial holes are dug to locate and record exact position of existing services. Trial holes are important to identify existing services before any excavations can be started. The overarching approach is to expose the cable to be removed at an equal distance between 300m spaced joint bays. This in effect means a cable pull of approx 150m undertaken from each joint bay.

5.1.2 Oil removal
The resident oil is blown from the cable and captured and contained securely. This oil is prepared for shipment and recycling.
5.1.4 Cable cutting

The cable is then cut at this point. There will always be an amount of oil left in the cable when it's cut due to the fact that all the oil cannot be removed in its entirety. This is residual oil leeching from the insulating papers that have absorbed the oils. This residual oil can be fully contained using a vacuum vessel and drip tray. The exposed end of the cable is capped to prevent any further seepage of residual oil.
5.2 Drill – cable loosening

At one end of the cable a JSM designed cable loosening tool head is slotted over the cable. This head is connected to a directional drill rod and in turn connected to a directional drilling rig.

The directional drilling rig pushes the cable loosening tool along the route of the cable, whilst at the same time pumping in Bentonite fluid through the head to create a 'flotation environment' around the cable. This both aids the removal of material immediately surrounding the cable and the extraction of the cable itself. Because of the design of the cable loosening tool head it will never deviate from the course of the cable.

Once the cable loosening tool has completed its route along the length of the cable and arrived at the exit hole. The tool is removed from the directional drill rod and the rods retracted back through the void made by the loosening tool.
5.3 Cable pull

The final part of the cable extraction process is the actual removal of the cable. A specially designed pulling head is slid over the end of the cable and grip collets fitted into the housing whilst being tight around the cable. The pulling head is then coupled to the end of the drilling rod which in turn is located in the HDD rig.

With the HDD rig in reverse, the slack is taken up on the pulling head and as the pulling pressure increases the collets within the pulling head housing tighten further around the cable.

As the pressure increases further the suction which is retaining the cable and created by the Bentonite around the cable releases and the HDD rig pulls the cable from its buried location.

This process continues until the length of the HDD rod extends as far as it can go. At this point the pulling load is released by the HDD rig and the pulling head is released and collets removed and slid back down the next length of cable and the collets reinseted.

The exposed cable is cut to appropriate lengths for transportation and recycling. Drip trays are located underneath the proposed cut points to collect any residual oil still existing in the cable. The exposed ends are then capped to retain any oil in the cut cable length.
5.3.1 Filling the cable void

Once all the cable has been removed from the ground a smooth bore void is left. There are a number of options open to us for utilizing this void.

Grouting

As rods are removed a specialized environmentally appropriate grouting mix can be pumped into the void which will resist any void collapse or subsidence.

Reuse of cable voids

Before the cable pull process begins, a utility duct can be attached to the end of the cable such that as the cable is pulled and recovered the duct is pulled straight into the void left by the recovered cable. This is an innovative use of the cable route for resale or leasing especially on major roads, busy roads, river and rail crossings

Innovative reuse of cable voids

Utility ducting systems can be pulled into the void left by the recovered cable and part of the cable pull process.

5.4 Materials recycling

Oil

The oil recovered from the decommissioned cable will be removed from site and recycled, refined and reused in a number of different applications.

Once cable has been removed from the ground it will be security tagged using Smartwater for both security and to ensure material is fully traceable. Cable lengths will be transported to a nominated and approved material recycling specialist, C.F. Booth of Rotherham where it will be stripped down into its constituent parts.
JSM have been working with C.F Booth of Rotherham to fully understand the complete recycling process for every cable removed from the ground and sent for stripping and recycling. As a result we have now established what happens to each constituent part of the cable.

The cable goes through a stripping process where the PVC outer sheath, copper, lead and papers are separated. Any residual oil is captured and contained at this stage.

Copper
Turned into Copper shot and distributed to buyers for reuse into various products including copper cable products.

Plastics/PVC
Turned into granules and sent to Manchester Plastics to be turned into equestrian surfacing and products such as police/road cones.

Lead
The lead is removed and collected by a specialist lead recycler and processed and refined to manufacture lead rolled sheeting used in the construction industry.

Papers
The papers, because of the oil content has a Calorific Value (CV) and as such is partly used to fuel the smelting furnaces and partly to add small carbon content to the manufacturing of specialist metals used in the marine and defence industry.
Annex 2
Method Statement

Walford Sealing End Compound to Joint bay 11/12 400kV Cable circuit Section Removal

THERE MUST BE NO DEVIATION FROM THIS METHOD STATEMENT

WITHOUT PRIOR APPROVAL FROM THE NG ENGINEER

Distribution:

<table>
<thead>
<tr>
<th>JSM</th>
<th>Project/Contract Manager, Supervisor/Site Person in Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>Grid Projects</td>
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</tr>
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<tr>
<td>Area Hospital</td>
<td></td>
</tr>
<tr>
<td>Hereford County Hospital</td>
<td>+44 (0) 1432 355444</td>
</tr>
<tr>
<td>Stonebow Road, Hereford,</td>
<td></td>
</tr>
<tr>
<td>Herefordshire, HR1 2ER,</td>
<td></td>
</tr>
<tr>
<td>JSM Contract Manager</td>
<td>John Fitzgerald</td>
</tr>
<tr>
<td>JSM Technical Manager</td>
<td>David Martindale</td>
</tr>
<tr>
<td>JSM Team Leader</td>
<td>Declan Wilson</td>
</tr>
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<th>Revised</th>
<th>Checked</th>
<th>Approved</th>
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<tr>
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<td>J. Fitzgerald</td>
<td></td>
<td></td>
<td>Ian Ford</td>
<td>Draft for comment</td>
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<tr>
<td>1</td>
<td>17/10/2013</td>
<td>J. Fitzgerald</td>
<td></td>
<td></td>
<td>Ian Ford</td>
<td>Issue for work</td>
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</table>

Ref JSM/P/JF/ROY120
Method Statement
For
SEC Compound to Joint bay 11/12 400kV Cable circuit
Removal

Date: 13/09/2013
Reference No: JSM/P/JF/ROY 120
Issue: 1
Client: NG
Written By: NG
Approved By: John Fitzgerald

Note:
Before any works are carried out the Competent Person (CP) in charge of the working party must ensure that the safety precautions are taken to establish General Safety at the vicinity of the work place. This CP must ensure that all times during the work that general safety arrangements are maintained and that all other work areas are not adversely affected by the activities for which they are responsible. The discharging of responsibilities for general safety will be achieved as part of the normal pattern of management delegation and control by ensuring that all activities are carried out in accordance with appropriate instructions and guidance.
It is imperative that continual monitoring of the works is carried out and regular communication between the CP and the SAP are established from the beginning of the works.

PURPOSE:
The purpose of this method statement is to describe the safe procedures for removing the redundant cable route section via the no dig method between SEC and joint bay 11/12 as identified on Grid drawing no. (70/2837, Sheet 4) in accordance with the Management of Health & Safety at Work Regulations 1999.

SCOPE OF WORK:

- Attend EAW PC’s site induction to CDM area.
- Carry out daily risk assessments and task RAMS briefings.
- Set up access to and site boundaries as per CDM area plan (attached).
- Consult current service drawings.
- Cat scan & locate all know 3rd party services at areas to be excavated.
- Earth down circuit cables to eliminate impressed voltages (see separate RAMS)
- Excavate HDD launch and receive pits, over the circuit to be removed, insert shoring or batter excavations as required.
- Cables are drained of free oils, allow to Remove any residual leeched cable oils in all three phases of the circuit.
- Receive permit to cut/spike cables from PC or the SAP.
- Spike, cut and cap cables adjacent to joint bay 11/12, copper caps x 3 on joint bay side, heat shrinks on open cable side x3 including pilot cable.
- Set up HDD rig and de-bond cables from backfill.
- Once loosened commence recovery process per phase x3.
- Backfill void using bentonite slurry additive.
- Recover any excess drilling fluids/bentonite (gully sucker)
- Cut cables and temporarily seal ends for transport to be processed/recycled.
- Backfill and compact launch and receive pits.
- Remove fencing and leave site clean and tidy as found.

Ref JSM/P/JF/ROY120
SAFETY GOALS:

- No lost time injuries.
- No environment damage incidents.
- No loss of production/output as a result of any safety related incident.
- Any safety related event will be honestly and immediately reported and investigated with lessons learnt to prevent any recurrence.
- Unsafe behavior will not be tolerated by anyone.
- Individual’s behavior at site will be closely monitored ongoing throughout the contract with records kept.
- Anyone has the right to refuse to work if their safety or anyone else’s is compromised in any way as a result of their work activities. Any refusal to work on safety grounds will be investigated to obtain lessons learnt to prevent a recurrence.
- Everyone employed/involved with the project will be regularly consulted during the project to obtain good ideas, any complaints or suggestions for improvement.

LOCATION:

SUPERVISION CONTACT LIST:

<table>
<thead>
<tr>
<th>Company and Name</th>
<th>Job Title</th>
<th>Tel No</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Grid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JSM Construction Ltd</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

KEY SAFETY ISSUES:

Main Hazards:

The main hazards associated with the excavations are:

- Striking Underground services
- Working at height (above an open hole/excavation)
- Working in Excavations (access and egress)
- Contact with live electric
- Damage to live cables
- Falling from Height (into excavations/trenches)
- Use of Ladders
- Moving Plant/ adjacent site traffic
- Safety of other contractors on site
- Noise
- Manual Handling

Ref JSM/P/JF/ROY120
Control of Hazards:

- Undertake a site visit to ascertain the nature of the site
- Assess all local conditions and restrictions that are likely to affect the execution of the works.
- Complete risk assessments for all potential hazards that are identified.
- Obtain the relevant utility drawings for the services identified in the area.
- Install adequate edge protection to all excavations.
- Provide safe access and egress routes into and out of all excavations.
- Follow safe working practices when working around cables.
- Notify users of the site haul road of disruptions.
- Wear all mandatory PPE for the task.
- Share lifting tasks with other comrades or use mechanical means where possible.

RISK ASSESSMENTS:
Main relevant JSM H&S Risk Assessments (but not limited to):

<table>
<thead>
<tr>
<th>Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA02 Avoidance of underground services</td>
<td>RA25 General Housekeeping</td>
</tr>
<tr>
<td>RA05 Safe access and egress</td>
<td>RA30 Plant and Machinery</td>
</tr>
<tr>
<td>RA06 Site Security</td>
<td>RA31 Portable Power Tools</td>
</tr>
<tr>
<td>RA07 Site vehicles and Traffic</td>
<td>RA33 Welding and cutting</td>
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<tr>
<td>RA08 Use of Hand Tools</td>
<td>RA35 Fire Safety</td>
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<tr>
<td>RA17 Manual Handling</td>
<td>RA40 Abrasive Wheels</td>
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<td>RA19 Excavations and trenches</td>
<td>RA46 COSHH</td>
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<tr>
<td>RA21 Working at Height</td>
<td>RA52 Weils Disease</td>
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</table>

The risk assessments listed above cover the common activities and hazards associated with the scope of works, however an on-site specific risk assessment should be carried out prior to or just commencing the works. If it is found necessary, any additional hazards should be identified and the scope of the risk assessments should be reviewed or extended.

Main relevant JSM Environmental Risk Assessments (but not limited to):

Ref JSM/P/JF/ROY120
The risk assessments listed above cover the common activities and hazards associated with the scope of works, however an on-site specific risk assessment should be carried out prior to or just commencing the works. If it is found necessary, any additional hazards should be identified and the scope of the risk assessments should be reviewed or extended.

**Key Risks and Controls:**

<table>
<thead>
<tr>
<th>Risks</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back Strain / Injury</td>
<td>• Manual handling will be kept to a minimum.</td>
</tr>
<tr>
<td></td>
<td>• Materials will be removed using a bucket &amp; rope and transferred to waste point, using wheelbarrows.</td>
</tr>
<tr>
<td></td>
<td>• Personnel have been trained in manual handling techniques</td>
</tr>
<tr>
<td></td>
<td>• See procedure SP006</td>
</tr>
<tr>
<td>Slips, Trips &amp; Falls</td>
<td>• Plan all operations prior to commencement of works.</td>
</tr>
<tr>
<td></td>
<td>• Maintain site tidiness.</td>
</tr>
<tr>
<td></td>
<td>• Remove waste on a regular basis.</td>
</tr>
<tr>
<td></td>
<td>• Excavation guarded &amp; warning signs displayed.</td>
</tr>
<tr>
<td></td>
<td>• See procedure SP027</td>
</tr>
<tr>
<td>Access and Egress to</td>
<td>• Use correct access and egress routes to work areas</td>
</tr>
<tr>
<td>excavations</td>
<td>• Install ramps or steps into excavations to provide the safest means possible</td>
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<td>• Ensure all edges have edge protection installed</td>
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<td>• Ensure an escape route is always present and</td>
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</table>
| **Method Statement**  | **For** SEC Compound to Joint bay 11/12 400kV Cable circuit Removal | **Date:** 13/09/2013  
**Reference No:** JSM/P/JF/ROY 120  
**Issue:** 1  
**Client:** NG  
**Written By:** John Fitzgerald  
**Approved By:** |
|----------------------|----------------------------------------------------------------------|------------------------------------------|
| **Noise**            | • Use of appropriate machinery and equipment  
                      | • Ensure all machinery and equipment is well maintained  
                      | • Provide and use ear protection  
                      | • See Safety procedure SP008 |
| **Weil’s Disease**   | • Wear gloves and protective clothing  
                      | • Wash well before taking food and drink  
                      | • Clean cuts and abrasions thoroughly and cover with waterproof dressings  
                      | • See procedure SP017 |
| **Conductive Apparatus** | • Permits to work in place  
                          | • Safe working distances established before entry  
                          | • All personnel trained to the clients specific standard for working on cables  
                          | • NSI 5 procedures to be in place and maintained |
| **Working at Height** | • Herris Fencing  
                      | • Secure ladder  
                      | • Adequate access/egress  
                      | • Housekeeping  
                      | • Excavation security  
                      | • Keep ladder rungs and footwear free from slippery substances (e.g. mud, oil etc)  
                      | • Use fall arrest system and edge protection where required |
| **Vehicular Movements** | • Works area fenced off  
                      | • Banksman present for all vehicular movements on site  
                      | • Signing, Lighting & Guarding as per chapter 8 |

Ref JSM/P/JF/ROY120
Safety Procedures:

<table>
<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
<td>SP002 Avoidance of underground</td>
<td>SP032 Portable Electrical Appliances</td>
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<td>services</td>
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<td>SP003 Excavations</td>
<td>SP034 Electricity Safety Distribution Rules</td>
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<tr>
<td>SP006 Manual Handling</td>
<td>SP035 COSHH</td>
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<td>SP008 Noise</td>
<td>SP060 Fluid management procedure</td>
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<td>SP010 PPE</td>
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<td>SP020 Working on or near water</td>
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<td>SP025 Confined Spaces(excavations)</td>
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<tr>
<td>SP027 Slips, trips and falls</td>
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<tr>
<td>SP017 Weil’s disease</td>
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</table>

SEQUENCE AND METHODOLOGY:

Methodology for Main Works:

- The site is to be set up and protected with signing and guarding in accordance with "the red book" and/or the agreed site CDM lay out.
- The sites will be secured using heras fencing with will be attached together using two number clips.
- All traffic and pedestrian management will be put in place before any work starts.
- Existing services drawings will be made available and known services will be marked up using spray paint.
- Any services in close proximity (500mm) to the redundant 400kV cables will be trial holed to prove depth and location.
- The redundant 400kV route’s exact location will be traced and marked up using the CAT and Genny.
- The launch pit will be dug to the West side of the Walford SEC to a size of approx 3m long x 1.2m wide x 1.0m deep using an 8ton tracked excavator.
- The receive pit will dug to the east side of Joint bay 11/12 and will be approx 3m long x 1.2m wide x 1.0m deep.
- Once the existing cut ends of the cables have been exposed at the launch pit, all remaining internal leeched oils will be purged from the cables using compressed air and collected in oil drums sited in suitable drip trays. The oil will be recovered and taken to storage for further recycling by NG.

Ref JSM/P/JF/ROY120
Before spiking the cables it will be confirmed that all leached oils have been removed from all 3 phases and that the hydraulic section is de-pressurised. This will be confirmed in writing to the civils team by the JSM technical manager before any cutting or spiking is carried out.

It will be necessary to spike all 3 cables to confirm that they are dead, this will be carried out by a competent person in the use of the cable spiking gun.

The cables will be cut using a hydraulic cable shears above a suitable sized drip tray to capture any leaching oils from the cables. All oils recovered will be recorded and transferred to a waste oil drum on a bunded base for safe keeping until collected for recycling off site.

The remaining oil insulated cables to be left in situ will be capped off using copper cable caps plumbed to the cable (Lead) outer sheath.

The HDD boring machine will be set up to the east side of the launch pit, with herras fencing and debris netting to the perimeter of the immediate launch site area.

**HDD System Set-Up**

- A D36 Vermeer Navigator HDD rig is to be used for the extraction.
- The HDD machine is firstly aligned in the direction of the proposed bore. Once the machine has been sited in a suitable position, the hydraulic carriage is then lowered and securely anchored to the surface of the ground.
- On the D36 HDD rig the anchoring system used is a hydraulic auger system capable of inserting 2 no flight augers in to the ground at various positions.
- Each auger measures 1.2 metres in length, which are driven through the steel ground plates located on the base of the machine. This forms the basis of the anchoring system.
- Once the machine has been secured in position, the beacon or transmitter is then checked for both battery life and calibration.
- The beacon / transmitter is then located at the front of the drill string.

Ref JSM/P/JF/ROY120
Method Statement
For
SEC Compound to Joint bay 11/12 400kV Cable circuit Removal

- The drilling unit is powered by an independent power pack unit located on the drilling rig. By the sheer nature of its design the HDD units have extremely high torque, forward thrusting, pull back, and rotational forces.
- In the case of the D36 the fluid management system is housed in a purpose made vehicle. Drilling fluid is prepared to the required consistency and viscosity for the ground conditions. Drilling fluid is then transferred to the HDD unit by an umbilical cord attached to the rear of the HDD unit.
- Fluid requirements are supplied on a demand basis controlled by the rig operator.
- Drilling fluid is injected through the rods to: (a) cool the leading head and, (b) to assist in cutting/softening the ground directly in front of the drilling head.
- Two drilling mediums are generally used, water or polymer, the choice of which will be dependent on the ground conditions identified during the drilling survey.

General Pilot Drilling

- As the drilling commences the drill head is continually monitored using a signal from the beacon/ transmitter as described above. The signal is received by a hand held tracking device that progressively tracks the head. The information received by the tracking unit indicates the line of the bore, as well as depth and pitch angle.
- As the piloting head progressively moves forward, a member of the drilling team walks slowly over the line of the bore, so that any steering adjustments can be made should the line of the bore deviate from the one planned. The existing cable will provide a permanent guide for the head to follow at all times, however it is good practice to confirm location and depth at all times. Where it is not possible to manually track the progression of the pilot head a high-powered sonde and remote tracker would be utilised.
- When in remote tracking mode all steering information is automatically relayed back to the drill operator on his steering console.

Cable debonding

- On completion of the cable debonding operation, the drill head is then removed from the drill string and detached from the HDD rig.
- The cable extractor is then fitted to the cable and attached to the HDD rig pulling head via a 20 ton shackle , the cable will be pulled out of the bore and cut into 5 or 6m sections for loading into the bunded skips.
- The final diameter of the bore will be approx 200mm.
  A bentonite grout mix will be utilised during the drilling operations to aid with smooth operations during the extraction procedures.
- The exit side operations are controlled by the tracker through radio communication with the drill operator to ensure that the drill head is not rotated until personnel are clear of the head and it is safe to proceed.

Ref JSM/P/JF/ROY120
Cable Pullback

- On completion of the debonding, the cables will be attached to the rig string via an integral swivel for pulling. Once each cable string has been removed the HDD rig will be connected back to the drill rod string, drilling fluid is pumped through the rods to introduce bentonite filler mix and the drill rods are pulled pack towards the rig. The drill string is then disconnected and the equipment de-rigged in readiness for repositioning the rig for the subsequent debonding shots.

Breakout of drilling Fluid.

- There is some risk that some drilling fluid may escape the borehole during drilling or pullback due to a combination of drilling pressures and fissured/porous ground. This could manifest itself as seepage to the surface. Contamination will be contained and cleaned up by sand-bagging around the affected area and removing drilling fluid by a vacuum tanker.
- Surplus drilling fluid, if any, will have to be recovered from the entry/exit pits after the cable has been extracted. This will be recovered by a specialist waste management company using a vacuum tanker to collect and dispose off site to a licensed waste disposal facility. JSM Construction Limited are responsible for removal of drilling fluids unless otherwise stated.

Drill fluid Break out Response Strategy

- For all pollution incidents the following initial action points are:

STOP – All work associated with the incident in the immediate area shall cease.

CONTAIN – Contain spills by utilising spill kits, absorbent granules, sand, earth or any suitable materials to hand. Trenches should be dug where appropriate to stem flows of pollutants. Special attention should be made to block or divert any spills from entering Drains and Watercourses.

NOTIFY – Clients Project Management (as appropriate). When client representatives are not available, or for large spills (over 20 litres, other than Bentonite), or any contamination to a watercourse (including Bentonite), notify the EA / SEPA directly.

RECOVER – Recover spills utilising absorbent pads, skimmers or booms etc. Large spills may require clean up advise from the EA / SEPA as necessary.

DISPOSAL - Bag and dispose of all contaminated materials in accordance with Waste Management Procedures.
Transporting and Disposal of Drilling Mud

- The drilling mud is to be recovered from pits, at the completion of each cable extraction bore by vacuum tanker and either transports it between the exit and entry side, for re-use at the next location or disposed of offsite to a licensed disposal facility. JSM Construction Limited are responsible for transport and disposal if taken of site.

- The launch pit will be lined with polythene sheeting to collect any drips before cable removal work begins
- Removal works will begin from the launch pit and progress towards the receiving pit at the opposite side of the site next to JB 11/12.

- Once the first cable has been released from the stabilised backfill it will be extracted via the HDD boring machine using the JSM progressive grip pulling head.

- The cables will be cut into manageable lengths of approx 5m and temporarily sealed ends to be loaded into a bunded roll on roll off skip supplied by the cable recycling specialist.
- It is intended to extract a 150m length of cable pulling from West to East.
- During the removal processes the remaining voids will be filled with bentonite to expand and fill any remaining voids. The Bentonite mixing procedure is detailed in the attached data sheets for each type of bentonite mix to be used. In general the mixing takes place in the mixing truck which will be positioned close to the HDD rig, the bentonite is contained in paper bags similar to cement bags and is fed into the mixer/pump via the loading hopper. The bentonite can then be mixed to the correct consistency as required by adding water and where required

Ref JSM/P/JF/ROY120
polymer can be added to aid lubrication. All drilling fluids used are non hazardous as explained on the attached COSHH sheets.

- Once all cables have been extracted the excavations will be backfilled to match existing surfaces. All top soil and growing medium will be replaced as found.
- The excavated sites will be reinstated to as found conditions or better.
- Trial holes can be dug to provide assurance of sufficient backfill of the cable bores.
- All fencing and debris will be removed from site.
- An exact record will be submitted to National Grid to confirm what cables were removed and the exact location of remaining cable ends.

MANAGEMENT AND PERSONNEL:

Management, Training and Certification:

It shall be the responsibility of the JSM Construction Management:

- To ensure that no works proceed before written approval of the method statement and risk assessments has been received.
- To ensure that all operations are completed in a safe manner.
- To ensure that all operatives are correctly inducted and trained for the task in hand.
- To ensure that all staff are briefed on the approved method statement and identified risks for the project.
- To brief the team on the emergency arrangements for the project.
- To make the approved method statements and risk assessments available to all staff working on site.
- To ensure that all JSM and sub-contracted personnel are issued with all relevant safety equipment to carry out works.
- To identify all Health, Safety and Environmental hazards, and any permits and licenses required.
- To revise the method statement and risk assessments as required.

Personnel:

- All personnel shall attend a EAW site induction course prior to the work commencing.
- All personnel will be briefed on the site specific risk assessments and method statements.
- All personnel shall have been selected based upon their qualifications and experience of the operation.
- All personnel will have been made fully aware and have access to all relevant site controlled documentation, including method statements, risk assessments, COSHH data sheets and the Site Safety Procedures Manual.
- All personnel will wear at all times the appropriate PPE as deemed necessary by the risk assessment.
- All personnel will be trained and qualified for the task in hand.

Ref JSM/P/JF/ROY120
Welfare Arrangements:
- The existing site welfare units will be utilised by the workers to take breaks, change and dry clothes and use the welfare provisions.
- All teams will be equipped with hand cleaner, fresh drinking water, wet weather clothing.
- The work force will take refreshments in the existing welfare units on site.
- Toilets and hand washing facilities will be available on site.

TRANSPORT, PLANT, EQUIPMENT & MATERIALS:

Access/Egress:
- All works are to be confined to a clearly barrier/signed off area, only to be entered by JSM employees.
- Access shall be maintained for the Emergency Services at all times.
- Vehicular movements accessing and egressing the site will be done under the supervision of a competent Banksman.

LOGISTICS (deliveries/materials):
- For delivery and disposal of materials/equipment, vehicles will be brought as close as possible to the work site for the minimum length of time.
- A competent Banksman will be used for the reversing of all vehicles.
PLANT & EQUIPMENT:

All plant shall be certified as being safe and in accordance with the Provision of Use of Working Equipment Regulations (PUWER) and fit for purpose

<table>
<thead>
<tr>
<th>JSM Plant Details</th>
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<tbody>
<tr>
<td>Hand tools</td>
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<tr>
<td>Herras Fencing /with debris netting</td>
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<tr>
<td>8 Ton excavator</td>
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<tr>
<td>Shoring timbers</td>
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<tr>
<td>Water pump with dirt/silt bags</td>
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<tr>
<td>TM chapter 8 signing and guarding</td>
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<tr>
<td>3 ton dumper</td>
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<tr>
<td>Metal Drip trays</td>
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<td>Jointers tools</td>
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CONTROL AND MEASURING, TESTING OF EQUIPMENT:

Evidence of maintenance of CAT scanner and lifting equipment will be held in the site safety file and random checks will be carried out and added to the register by the site management.
COSHH:

COSHH Assessments

All substances will be accompanied by the relevant COSHH assessments.

<table>
<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Petrol Unleaded (generic)</td>
<td>Cable oil</td>
</tr>
<tr>
<td>Diesel fuel</td>
<td>Bentonite drill fluid (ultra bore)</td>
</tr>
</tbody>
</table>

PERSONAL PROTECTIVE EQUIPMENT:

All operatives will be issued with personnel protective equipment (PPE) in accordance with the PPE regulations 1992.

The following PPE will be used on site:
- Flame retardant overalls (Mandatory)
- Gloves including (Mandatory) anti-vibration gloves where applicable
- High visibility clothing (Mandatory)
- Safety footwear (Mandatory)
- Ear defenders (as required but must be on persons)
- Goggles (Mandatory)
- Dust masks (as required)
- Hard hat (Mandatory)
- Eye Protection (Mandatory)

EMERGENCY PROCEDURES:

Emergency Contact List:

<table>
<thead>
<tr>
<th>Emergency Contact List</th>
<th>Company and Name</th>
<th>Job Title:</th>
<th>Tel No:</th>
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</thead>
<tbody>
<tr>
<td>Company and Name:</td>
<td>Job Title:</td>
<td>Tel No:</td>
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<td>National Grid</td>
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<tr>
<td>JSM Construction Ltd</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Services</td>
<td>999</td>
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Ref JSM/P/JF/ROY120
Emergency Procedures:

- In the event of an emergency, medical or otherwise, it is necessary to contact key JSM staff using the numbers listed, who in turn will inform the PC, Client and JSM Group Health Safety & Environment department.
- If an incident does occur it must be reported to the JSM Project Manager, who in turn will inform JSM Group Health Safety & Environmental department, the PC's project manager and the Client immediately.
- All accidents and incidents must be recorded within the Site Safety Procedure File and reported to the site NG SAP and the Principal Contractor.

Ref: JSM/P/JF/ROY120
Local Hospital:

Hereford County Hospital, Stonebow Road, Hereford, Herefordshire, HR1 2ER, +44 (0) 1432 355444

Driving directions to The County Hospital

A Walford HR9 5QW UK
1. Head southeast toward Walford Rd/B4234
2. Turn left onto Walford Rd/B4234
   Continue to follow B4234
   Go through 1 roundabout
3. Turn left onto High St/B4260
   Continue to follow B4260
4. At the roundabout, take the 3rd exit onto A49
   Go through 2 roundabouts
5. At the roundabout, take the 2nd exit onto Newmarket St/A438
   Continue to follow A438
6. Turn left onto Commercial Rd/A465
7. Turn right onto Stonebow Rd
   Go through 1 roundabout
   Destination will be on the right

B The County Hospital
Stonebow Rd
Hereford HR1 2BN, United Kingdom

Ref JSM/P/JF/ROY120
Utility emergency contact details

<table>
<thead>
<tr>
<th>Service</th>
<th>Contact</th>
</tr>
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<tbody>
<tr>
<td>Electric - WPD</td>
<td>0800 328 1111</td>
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<tr>
<td>Gas</td>
<td>0800 111 000</td>
</tr>
<tr>
<td>Water – Welsh Water</td>
<td>0800 052 0130</td>
</tr>
<tr>
<td>BT:</td>
<td>0800 800 151</td>
</tr>
<tr>
<td>National Grid</td>
<td>0800 404 090</td>
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</table>

ENVIRONMENTAL ISSUES:
- All works will be undertaken with due care and consideration for the environment, public and any local residents.
- All works will be in accordance with the Environmental Protection Act 1990.
- All Teams will be in possession of emergency spill kits.
- All Management must make sure that the Site Waste Management Plan is up to date.
- Contact JSM Environmental Dept for further advice (Dawn Wright 07730 219 860)
Environmental Site Rules

1. Housekeeping Policy

JSM will ensure all construction and administrative areas to have a high level of cleanliness and tidiness with clear access routes maintained at all times. Areas of the site will be designated for the storage of plant, equipment, materials and waste these will not be within 10 metres of a watercourse.

2. Litter

Strictly "NO LITTERING" on the site. Litter and food wastes to be disposed of at the compound or designated areas where all site welfare facilities are maintained.

3. Animals

Where the working environment contains livestock and wildlife; these should be respected and not interfered with.

4. Ecology

Nesting birds and other wildlife, in, or close to the working area, must not be disturbed. Trees and hedgerows may not be removed without prior permission from the Clients Project Manager.

5. Site Drainage

There will be no discharges directly to a watercourse or surface water drain without an Environment Agency Consent. Water should not be discharged to areas of land which are waterlogged. Surface run-off should be channeled away from watercourses. Water used to wash tools and equipment must not be allowed to enter watercourses or surface water drains.

6. Excavations

No excavations shall take place without checking that any archaeological or ecological requirements have been complied with. The discharge of any water from excavations must comply with the requirements of site drainage. Stockpiles of clean soil, intended for re-use should be located away from watercourses or surface water drains.

7. Speed Limits

The following specific speed restrictions apply:

- max speed of 5 mph in any site compound area

Ref JSM/P/JF/ROY120
8. Oil and Chemical Storage

JSM will designate areas of the site for the storage of oil and chemicals. These areas of hard standing will be a minimum of 10 metres from a watercourse or surface water drain.

9. Refueling and Maintenance

Refueling only to take place over spill trays, and where possible within the designated areas. If a spill occurs it will be attended to immediately with the use of a spill kit, which will then be double bagged and sealed, return to Leven Road depot to designated area for collection. Or if there is a dedicated skip at Ross site, get permission from site manager before placing items in skip. Team to ensure yard man is notified to arrange collection from JSM approved contractor. A Dry Power Fire extinguisher is to be present on site went refueling takes place and operatives MUST ensure that they are wearing correct PPE.

10. Plant and Vehicles

The company will not permit the use of any plant or vehicle which is faulty or damaged. As a minimum all hydraulic hoses and connections will be inspected prior to use of the plant or machinery.

11. Spillage

All fuel spills / oil spills will be attended to immediately. Spills will be prevented from entering drains or watercourses. Spill kits will be available in all site vehicles, and in areas of the site where there is a risk of spillage, such as oil storage areas. All incidents will be reported to the Site Manager as soon as possible. Spill trays shall be capable of accommodating the volume being transferred plus 10%.

12. Discipline Procedure

A procedure will be implemented by JSM which provides a system of formal warnings. If persistent poor behavior or attitude is displayed individuals may be removed from site. The Owner reserves the right to require the removal of any individual person(s) from site.

13. Accident / Incident Reporting

All environmental incidents, are to be reported to the Site Manager, and to the Clients Site Representative as soon as possible, in any case within 24 hours, by phone, fax or email. Near miss reporting will be carried out by all on sites.

14. Public Nuisance

JSM will ensure it complies with any noise restrictions, and will not complete any work outside of the agreed working hours. **No fires will be lit on site.**

Ref JSM/P/JF/ROY120
**16. Dust Management**

Operatives will be provided with eye protection and respiratory protection where required. Dust elimination/reduction methods will be introduced (water spray etc) for the duration of the breaking the ground works, unless weather conditions allow otherwise i.e. heavy rain removes the need for damping down.

**16. Waste Management**

Surplus excavated materials arising from the works will be removed from site and taken to JSM Depot, Leven Road E14. Works will be in compliance with legislation. There will be no stock piling of any excavated spoil material on site.

It is not envisaged that contaminated land exists in the areas of work but the following actions will be taken:

- On the identification of contaminated land, stop works in the area and immediately, erect suitable fencing and appropriate safety signs enclosing the area;
- Ensure no further work is undertaken in the area;
- Install any protective measures to nearby sensitive receptors (water courses, other works etc);
- Notify JSM Project Manager who in turn who will in turn inform the JSM Group Health Safety & Environmental department and the Client immediately.
- JSM to action in accordance with company safety procedure and client requirements

**SECURITY:**

- Ensure materials plant etc stored securely and does not attract attention to its presence.
- Fencing to be erected around all welfare/storage/parking areas etc.

**FIRST AID:**

- There will be a fully trained Appointed Person on site at all times.
- All teams will be in possession of a first aid box.

**ACCIDENT & INCIDENT REPORTING:**

- The JSM accident book will be located at the JSM site office.
- The nominated person in charge on site will ensure that the Principal Contractor and the Client are informed of any such injuries/accidents.
- The Project Manager and the JSM Safety Director must be notified for investigation and/or reporting to the HSE where necessary.

Ref JSM/P/JF/ROY120
Reference Documents:
- JSM Construction Site Safety Procedures
- JSM Construction 'Gangers Pack'
- JSM or Contractors Site Safety Plan.

Method Statement prepared by:

Signature
Position:
Date

Method Statement Reviewed by

Signature
Position
Date

Ref JSM/P/JF/ROY120
**Method Statement Briefing Form**

**Date of Briefing:**

**Method Statement Title:** Walford Compound to Joint bay 11/12 400kV Cable circuit Removal

**Briefing given by:**

<table>
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<th>NAME CAPITALS</th>
<th>POSITION</th>
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**Briefed to:** (by signing below I confirm that I have received and understood the briefing)

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Method Statement
For
SEC Compound to Joint bay 11/12 400kV Cable circuit
Removal

Date: 13/09/2013
Reference No: JSM/P/JF/ROY 120
Issue: 1
Client: NG
Written By: John Fitzgerald
Approved By:

WALFORD SITE LAYOUT

Cable section to be removed

Ref JSM/P/JF/ROY 120
Method Statement
For
SEC Compound to Joint bay 11/12 400kV Cable circuit Removal

Date: 13/09/2013
Reference No: JSM/P/JF/ROY 120
Issue: 1
Client: NG
Written By: John Fitzgerald
Approved By:

JSJ access requirements and site layout

Extent of Pembroke circuit section to be removed

Use existing new cable circuits crossing point with bog mats for extra protection

Access to JB 11/12 via Existing easement adjacent to Pembroke circuit Cross over new circuits via established crossing point with bog mats put in place for extra protection. Boundary fence to be put in place to separate works from new circuits.

Ref JSM/P/JF/ROY120
Method Statement
For
SEC Compound to Joint bay 11/12 400kV Cable circuit
Removal

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Issue: 1
Client: NG
Written By: John Fitzgerald
Approved By:

CIRCUIT CABLE SECTION DRAWING

Ref JSM/P/JF/ROY120
Annex 3
Ross on Wye 400kV Oil Filled Cable Extraction For National Grid
We will take you through a step by step description of the JSM non intrusive cable extraction system. This trial is demonstrating how we can reduce the amount of excavation work in relation to conventional open cut methods and to reduce the disruptions caused to other third parties, but more importantly to envisage the unimaginable costs savings.
The influential rewards for this cable removal system are as follows:

- **Less** intrusive excavations and disruptive impact to traffic flows and society in general, ie: (dust/noise/machine movements/ open trenches/fallen barriers/traffic management complications/lane rental costs) etc..

- **Less** road transport trips for *Muck away* and return loads for backfill and *reinstatement* materials. Minimal *site traffic movements*

- Considerable *carbon footprint write-offs* with real measurable carbon savings

- Less Excavating = Less risks = Greater Safety = increased positive public perceptions
• Controlled cable oil management, no spills or contamination during removal

• 100% recycling of all cable components, no waste goes to landfill

• Environmental Sustainable process with minimal impacts to the environments

• Minimal impacts to ecological/conservation sensitive sites.

• Opportunity to reuse cable void to insert a valuable duct for future use or sale

• Last but not least LESS COSTS
Excavating the launch pit
Hand digging around cables
Ramped access, pits lined with oil proof membrane and concrete blinding to allow clean working
Cables earthed, purged with nitrogen and all free oils removed.
Cables spiked and cut, copper caps fitted
From sketches
To reality
DEMANDE OU BREVET VOLUMINEUX

LA PRÉSENTE PARTIE DE CETTE DEMANDE OU CE BREVET COMPREND PLUS D'UN TOME.

CECI EST LE TOME 1 DE 3
CONTENANT LES PAGES 1 À 87

NOTE : Pour les tomes additionnels, veuillez contacter le Bureau canadien des brevets

JUMBO APPLICATIONS/PATENTS

THIS SECTION OF THE APPLICATION/PATENT CONTAINS MORE THAN ONE VOLUME

THIS IS VOLUME 1 OF 3
CONTAINING PAGES 1 TO 87

NOTE: For additional volumes, please contact the Canadian Patent Office

NOM DU FICHIER / FILE NAME :

NOTE POUR LE TOME / VOLUME NOTE:
CLAIMS

1. A device for use in removing a conveyance member from a material, including:
   a coupling element for coupling the device to a shaft;
   a displacement element for being placed at least partly around a conveyance member and for displacing material as the device is advanced along a conveyance member;
   a driven component for receiving a driving force for driving the device through material; and
   a material loosener operable to loosen material ahead of the displacement element as the device is advanced along a conveyance member;
   wherein the material loosener includes a drilling element coupled to a first wheel and the coupling element includes a second wheel cooperating with the first wheel to transfer rotational movement of a shaft to the drilling element.

2. A device according to claim 1, wherein the first wheel is a sprocket.

3. A device according to any preceding claim, wherein the second wheel includes a perforated track.

4. A device according to claim 3, wherein the perforated track is provided on or in the displacement element, and the displacement element includes holes or perforations corresponding to and/or aligned with perforations in the perforated track, the holes or perforations of the displacement element passing all the way through the displacement element to allow material to be pushed through the displacement element.

5. A device according to any preceding claim, wherein the second wheel includes a chain of roller bearings.
6. A device according to any preceding claim, wherein the axes of the first and second wheels are substantially parallel.

7. A device according to any preceding claim, wherein the drilling element is coupled to a plurality of said first wheels and the coupling element includes a plurality of said second wheels, each second wheel cooperating with a respective first wheel to transfer rotational movement of a shaft to the drilling element.

8. A device according to any preceding claim, wherein the drilling element is operable to perform continuous and complete rotation.

9. A device according to any preceding claim, wherein the displacement element is configured for substantially surrounding a conveyance member.

10. A device according to any preceding claim, wherein the material loosener includes a spray for spraying fluid ahead of the displacement element.

11. A system for removing a conveyance member from a material, including:
    a device according to any preceding claim; and
    a driver including a shaft coupled to the device;
    wherein the driver is operable to provide a rotating force to the shaft.

12. A system according to claim 11, wherein the driver is operable to apply a forward force to the device.

13. A system according to claim 11 or 12, wherein the driver is operable to supply a fluid under pressure to the or a spray of the device.

14. A method of removing a conveyance member from a material, the method including:
placing a device according to any preceding claim on the conveyance member at or near a first end thereof;
advancing the device towards a second end of the conveyance member to loosen material adjacent to the conveyance member between the first and second ends; and
applying a substantially longitudinal force to the conveyance member to draw the conveyance member out of the material.

15. A method according to claim 14, including rotating a shaft coupled to the device as it is advanced to rotate the drilling element.
Fig. 8