1. SCOPE

This Section of the Live Working Manual details the procedures to be followed when mobile generators are synchronised onto (and off) the **System** to maintain supply during pre-arranged work or fault repairs.

The variety of synchronising systems utilised by generator hire contractors is acknowledged within this Section. Accordingly, generator hire contractors' staff may be authorised to undertake synchronising operations. Method statements for such synchronising operations shall be developed by the generator hire contractor and agreed prior to use with Engineering & Transmission Operations.

The procedure does not deal with the connection to or disconnection from, an isolated part of the **System.** This is covered by Non Operational Authorisations.

2. ISSUE RECORD

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Issue Date	Issue No	Author	Amendment Details
March 1999	A	R.L. Nelson	Initial Issue
10/02/04	2	W. Leggat	Amendments to Sections 10 and 13
03/03/09	3	Ken Lennon	Addition in Table 1 to include use of Ten 47 adaptor kits for Henley pole mounted fuse units.

3. ISSUE AUTHORITY

Author	Owner	Issue Authority
Name: W. Leggat Title: Team Leader EN Transmission Operations.	Name: Phil Currie Title: Policy and Operational Safety Manager	Name: Doug Wilson Title: Health and Safety Director  …… Date: …02/06/09……

4. REVIEW

This document shall be reviewed as dictated by business change. The proposed revision date can be viewed in the Live Working Manual Document Index DOC-00-236.

5. CONTENTS

6. DEFINITIONS

Terms printed in bold are as defined in the ScottishPower Safety Rules (Electrical and Mechanical) 4th Edition

7. REFERENCES

HSE Guidance Note GS 38:	Electrical Test Equipment for Use by Electricians
Engineering Recommendation G84:	Recommendations for the Connection of Mobile Generators to Public Distribution Networks.

8. ASSESSMENT

All work on or so near **Live** exposed **LV** conductors that **Danger** may arise requires assessment before the commencement of work to ensure that **Danger** will not arise during the course of the work. This assessment will be carried out by either the **Authorised Person** who is to undertake the work or by a **Senior Authorised Person**.

In all cases, however, as part of the assessment, **Apparatus** shall be subjected to a routine inspection prior to the start of any work to ensure that **Danger** will not arise due to the condition of the **Apparatus**.

Should this inspection reveal any significant deficiency in the **Apparatus** which could give rise to **Danger**, no attempt shall be made to work on the **Apparatus** whilst it is **Live** until a **Senior Authorised Person** has been consulted and assessed the situation.

9. OPERATIONAL CONSIDERATIONS

Any user of mobile generation should be aware that there are a number of operational issues that require to be considered. These include, but are not restricted to, the following: -

- Earthing
- Protection
- Selection of Generators
- Siting of Generators
- Environmental.

Comprehensive guidance on the connection of mobile generators can be found in Engineering Recommendation G84.

10. TRAINING AND AUTHORISATION

Due to the numerous existing types of generator currently owned or hired by Energy Networks this procedure details the generic steps which must be followed when connecting a generator to, or disconnecting a generator from, the **System**. **Persons** who are authorised under this procedure must also have received training in the connection and operation of the individual type of generator.

The generic procedures considered are:

(a) ***WL-1.70***: **LV** generator with facilities to automatically synchronise onto the **System**
(b) ***WL-1.71***: **LV** generator with facilities to manually synchronise onto the **System**
(c) ***WL-1.72***: Disconnection of **LV** generators from the **System**

Given the variety of synchronising generators that may be supplied to Energy Networks from generator hire contractors, Energy Networks may, in accordance with MSP 5.1, authorise generator hire contractors' staff to WL1.70, WL 1.71, and WL1.72. This will enable generator hire contractors' staff to synchronise their generators on/off the **System**. The connection of generator leads to the **System** shall be carried out by an **Authorised Person** using **Approved** adaptors. Table 1 details all **Approved** adaptors. The generator hire contractor shall supply, control and update as required, 'equipment specific' method statements clearly detailing all steps which require to be undertaken to synchronise the generator onto the **System** and subsequently to synchronise the generator off the **System**. Such method statements shall complement Energy Networks Procedures WL1.70, WL1.71 and WL1.72 and shall clearly define the roles and responsibilities of all parties throughout the time the generator is connected to the **System**. A typical example of a method statement is shown in Appendix 1. These method statements, and any subsequent modifications, shall be agreed prior to implementation with Engineering and Transmission Operations.

11. PROCEDURES FOR CONNECTION OF TEMPORARY MOBILE GENERATORS IN PARALLEL WITH THE SYSTEM

11.1 Procedure WL-1.70 - Connection of LV Generator with Automatic Synchronisation

Step 1 Ensure that you are familiar with the facilities of the generator on site.

Step 2 Select the correct **Approved** adapter, from Table 1, for the part of the **System** which you are to connect onto.

Step 3 Carry out on site risk assessment to ensure that all hazards are controlled. Ensure that the connection system is such that access to **Live** terminals is restricted to **Authorised Persons** only. This may require a suitably **Authorised Person** to be present at the connection points at all times.

Step 4 Inspect the adapter and all other cables and fittings to ensure that they are in good condition. The cables shall be double insulated and if the inner insulation is visible the cable must not be used.

Step 5 Connect the adapter onto the **System** ensuring that any remote ends are safe. Appropriate PPE shall be worn when making this connection.

Note :- For connections onto overhead lines it is acceptable for an **Authorised Person** with WL1.21 authorisation to connect the adapters onto the overhead line.

Step 6 Connect the generator earth to a suitable Earth**.**

Note :- For connections onto overhead lines it is acceptable for an **Authorised Person** with WL1.21 authorisation to connect the adapters onto the overhead line.

Step 7 Connect the generator leads between the generator and the **Approved** adapters. This includes any auxiliary leads which may be required in order to operate the synchronising.

Note :- For connections onto overhead lines it is acceptable for an **Authorised Person** with WL1.21 authorisation to connect the cables onto the adapters.

Step 8 Start the generator and ensure that voltage, phase rotation etc. are correct.

Step 9 Switch generator to automatic synchronising mode.

When the generator has been synchronised onto the **System** it will normally be necessary to isolate the part of the **System** to be worked on. This isolation is not subject to this procedure but shall be carried out by an **Authorised Person.**

11.2 Procedure WL-1.71 - Connection of LV Generator with Manual Synchronisation

Step 1 Ensure that you are familiar with the facilities of the generator on site.

Step 2 Select the correct **Approved** adapter, from Table 1, for the part of the **System** which you are to connect onto.

Step 3 Carry out on site risk assessment to ensure that all hazards are controlled. Ensure that connection system is such that access to **Live** terminals is restricted to **Authorised Persons** only. This may require a suitably **Authorised Person** to be present at the connection points at all times.

Step 4 Inspect the adapter and all other cables and fittings to ensure that they are in good condition. The cables shall be double insulated and if the inner insulation is visible the cable must not be used.

Step 5 Connect the adapter onto the **System** ensuring that any remote ends are safe. Appropriate PPE shall be worn when making this connection.

Note :- For connections onto overhead lines it is acceptable for an **Authorised Person** with WL1.21 authorisation to connect the adapters onto the overhead line.

Step 6 Connect the generator earth to a suitable earth.

Note :- For connections onto overhead lines it is acceptable for an **Authorised Person** with WL1.21 authorisation to connect the adapters onto the overhead line.

Step 7 Connect the generator leads between the generator and the **Approved** adapters. This includes any auxiliary leads which may be required in order to operate the synchronising.

Note :- For connections onto overhead lines it is acceptable for an **Authorised Person** with WL1.21 authorisation to connect the cables onto the adapters.

Step 8 Start the generator and ensure that voltage, phase rotation etc. are correct.

Step 9 Follow the synchronising instructions for the generator.

When the generator has been synchronised onto the **System** it will normally be necessary to isolate the part of the **System** to be worked on. This isolation is not subject to this procedure but shall be carried out by an **Authorised Person.**

12. PROCEDURE FOR DISCONNECTION OF TEMPORARY MOBILE GENERATORS FROM THE SYSTEM

12.1 Procedure WL-1.72 - Disconnection of LV generators from the System (Synchronising off the system)

Step 1 Connect synchronising sensing equipment onto an appropriate part of the **System** and ensure that the link, either radio or wire, between the sensing equipment and the generator is connected.
The synchronising sensing equipment shall comply with HSE Guidance Note GS 38.

Step 2 Check phasing across point of isolation.

Step 3 Close the point of isolation between the **System** fed from the generator and the "normal" **System.**

Step 4 Open the output switch of the generator.

Step 5 Disconnect phase and neutral cables between the generator and the **Approved** adapters.

Note :- For connections onto overhead lines it is acceptable for an **Authorised Person** with WL1.21 authorisation to disconnect the cables from the adapters.

Step 6 Disconnect the generator earth cable.

Step 7 Disconnect **Approved** adapters from the **System.**

Note :- For connections onto overhead lines it is acceptable for an **Authorised Person** with WL1.21 authorisation to disconnect the adapters from the overhead line.

13. APPENDIX 1

ABC Hire Company

SUBSTATION: **DATE:**

SUMMARY OF CONTENTS

TO CONNECT GENERATOR, SYNCHRONISE & PUT ON LOAD

1. CARRY OUT ON-SITE RISK ASSESSMENT AND RETAIN COPY ON SITE.
   CHECK CONDITION OF ALL EQUIPMENT AND ENSURE IT IS FIT FOR USE. ☐

2. Ensure that the generator is installed on firm and level ground, in good working order, causing no hazard to other road users or the general public and that the leads are correctly protected with cable ramps. ☐

SECTION 1

SPPS AP ……TIME COMMENCED……..…

3. Check GENERATOR CIRCUIT BREAKER is in the open position. The GENERATOR CIRCUIT BREAKER shall be **Locked** and a **Caution Notice** applied. ☐

4. Connect EARTH cable from the generator to the earth connection on the **LV** panel. ☐

5. Check phase rotation on **LV** panel. Connect generator phase and neutral cables accordingly to **LV** panel using **Approved** connectors. ☐

6. Record the transformer load using a clamp ammeter. R= ☐
   Y=
   B=

   MAINS VOLTAGE= R – R= MAINS FREQUENCY=
   R – Y=
   R – B=
   R – N=
   Y – N=
   B – N=

7. Remove SPPS safety padlock and **Caution Notice** from generator circuit breaker. ☐

THE ABOVE ITEMS HAVE BEEN COMPLETED

SIGNATURE…… TIME……..

SECTION 2

ABC OPERATOR. ……TIME COMMENCED…….

8. Switch on the remote synchronising control system**.**
9. Switch on the mains/generator voltage sensing box. ☐
10. Switch off the voltage sensing. ☐
11. Confirm CB is in open position and start generator set. Allow generator to run and frequency to settle. ☐
12. Switch off G59 and earth fault protection. ☐
13. Check that both phase rotation meters are reading same. ☐
14. Check the mains voltage. By adjusting the voltage potentiometer bring the mains voltage to match the generator voltage. ☐
15. Repeat procedure 14 for the frequency meters using the frequency potentiometer. ☐
16. Set the “load command” potentiometer and set the synchronising mode switch. ☐
17. Set the load switch. ☐
18. Set the sync switch. The 3 green LED’s will extinguish as the generator synchronises with the mains. Once ALL 3 LED’s are unlit the generator will be synchronised with the mains. ☐
19. Check parallel across the generator CB using approved voltmeter. If potential difference is 30V or less then close generator CB by pressing the CB close button on the main panel. ☐
20. The generator will now be synchronised with the mains and have assumed a small percentage of the load. This is usually about 5% of the relevant generator’s full load capacity.
21. Switch the sync switch. ☐
22. By increasing the load potentiometer slowly, the full load can now be transferred to the generator (this allows a slow increase of load to the generator instead of one jump). **Note:** Should the load passed to the generator exceed 80% of the generator capability then the generator should be changed for a larger set. ☐

THE ABOVE ITEMS HAVE BEEN COMPLETED

SIGNATURE…… TIME……..

SECTION 3

SPPS AP ……TIME COMMENCED……

23. Once the full load has been taken by the generator then the transformer disconnectors may now be opened (This should be in the sequence of Blue, Yellow, Red). ☐

24. Advise OCC/NMC that transformer disconnectors are now open.

THE ABOVE ITEMS HAVE BEEN COMPLETED

SIGNATURE…… TIME……..

SECTION 4

ABC OPERATOR. ……TIME COMMENCED……

25. Confirm that there are no **LV** interconnections prior to setting the generator in island running mode. If an interconnection is present the generator will continue to produce further output load. **If this occurs do not proceed with the following steps and refer the matter immediately to the SPPS engineer on site.** ☐

26. As soon as it has been confirmed that no **LV** interconnection is present, switch the synchronising mode off. ☐

27. Switch off synchronising control system. ☐

THE ABOVE ITEMS HAVE BEEN COMPLETED

SIGNATURE…… TIME……..

TO BACK-SYNCHRONISE, TRANSFER LOAD TO MAINS & DISCONNECT GENERATOR

SECTION 5

ABC OPERATOR……TIME COMMENCED……

28. Switch on the remote synchronising control system. ☐

29. Switch to mains sensing system. ☐

30. Switch on the voltage-sensing system. ☐

31. ABC operator to witness SPPS engineer connect the red and blue voltage sensing leads to the red and blue phases on the transformer side of the **LV** panel. I.e. red and blue phases as defined by the generator connections onto the busbars. ☐

32. Adjust generator voltage and frequency to match mains voltage and frequency. ☐

    Switch on the sync switch

    The generator will now automatically synchronise with the mains. When synchronisation is complete the 3 LED's will go out and the sync indicator lamp will illuminate. The generator will now be synchronised with the mains and remain in sync for an indefinite period.

THE ABOVE ITEMS HAVE BEEN COMPLETED

SIGNATURE…… TIME……..

SECTION 6

SPPS AP ……TIME COMMENCED……

Before replacing transformer disconnectors continue with the following:

33. Check parallel across transformer isolators using approved voltmeter. With the sync indicator lamp illuminated and a potential difference across each isolator of less than 30V close the transformer disconnectors one by one in the sequence red, yellow, blue. ☐
    Immediately after the disconnectors have been replaced, the voltage sensing must be placed in the off position

34. Advise OCC/NMC that the transformer disconnectors are now closed.

THE ABOVE ITEMS HAVE BEEN COMPLETED

SIGNATURE…… TIME……..

SECTION 7

ABC OPERATOR……TIME COMMENCED……

The generator will remain in sync with the mains and will continue to carry the same load that was on the generator before going into island mode.

35. Switch off the sync system. ☐

36. To transfer the load from the generator, switch the load/unload switch to the unload position. This will transfer all but 5% of the relevant generator's full load capacity (the load indicator lamp on the remote sync indication box will go out when the power on the set is 20% or below, showing the load has now been transferred to the mains). This should be done as soon as the isolators are replaced. The generator will remain in sync with the mains until the generator CB is opened. ☐

37. Open generator CB. The remaining 5% of load will now transfer to the mains. ☐

38. The generator should now be allowed to run for a cooling down period of approx. 10 minutes before shutting down. ☐

39. After generator has been shut down ABC operator to witness SPPS engineer disconnect phase sensing leads. ABC operator to unplug the remote synchronising control system. ☐

THE ABOVE ITEMS HAVE BEEN COMPLETED

SIGNATURE…… TIME……..

SECTION 8

SPPS AP ……TIME COMMENCED……

40. Disconnect the generator phase and neutral cables from the **LV** panel and remove the **Approved** panel connectors. ☐

41. Disconnect the generator EARTH cable from the earth connection on the **LV** panel. ☐

THE ABOVE ITEMS HAVE BEEN COMPLETED

SIGNATURE…… TIME……..

14. TABLE 1

Litton Vean Part Number or Other supplier details	Adapter Description	Approved Use
Ten 47 Limited. Two part kit numbers 0114 and RS part number 163110	Adaptor kit to enable network connection to a Henley pole mounted fuse unit. Link to approval submission that includes photographs TSE-06-038	Facilitates synchronisation of generator to system whilst keeping customers on supply during outage conditions
LVD400	JW4ST fuse unit with integral generator connection	Used to replace existing $3^5/_8$ inch fuses. Generator cable connects into connector on new fuse carrier. Can be used to feed generator onto busbar. The carrier needs to be fitted with a standard fuse
LVD401	JW4ST fuse unit with integral generator connection	Used to replace existing $3^1/_4$ inch fuses. Generator cable connects into connector on new fuse carrier. Can be used to feed generator onto busbar. The carrier needs to be fitted with a standard fuse
LDFT	400A finger proof cable line drain connector	An in line connector used as a cable termination
PDFT	400A finger proof panel mounted drain connector	A connector to enable a standard generator cable to be terminated onto busbars or similar locations where there is a suitable hole in the busbar. This connection should be infrequently used.
LVC	Screw in end cap fuse	A replacement for the fuse carrier on a rotary type pole mounted fuse to enable the generator to be connected to the outgoing (bottom side) of the carrier
LVF	Insulated overhead line clamp	An insulated clamp suitable for connection onto open wire overhead lines to enable the standard generator cable to be connected
LVS	Insulated G style clamp	Used to provide a clamp connection onto the busbar of an open panel LV board. The standard generator is then connected to the adapter. **Not suitable for use on some older type boards.**
LVE500	Rotary style clamp	Used to connect onto the fuse spill of an LV board. Must be used the correct way up in order the connection does not become loose