

ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

MEETING NAME ISG 222

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Purpose of paper Information

Classification Public

Summary This paper provides the ISG with an update on the condition related to Metering Dispensation D/490. We invite the ISG to note the results of: the monthly 'below 100MW' reports; the April 2019 bipole 2 (BP2) Fibre Optic Current Transformer (FOCT) calibration report; the metering stability analysis; and National Grid Interconnectors Limited's (NGIC) proposals to monitor flows on the Anglo French Interconnector (IFA). ELEXON recommends that NGIC provides a summary report on the IFA monitoring to ELEXON in January 2020, with any potential actions it plans to enact during the BP2 outage in April 2020, and ELEXON will present the information to the ISG at its February 2020 meeting.

1. BSC requirements

- 1.1 [Section L](#) 'Metering' of the Balancing and Settlement Code (BSC) requires all Metering Equipment to either:
 - comply with the requirements set out in the relevant Code of Practice (CoP) at the time the Metering System is first registered for Settlement; or
 - be the subject of, and comply with, a Metering Dispensation.
- 1.2 Section L allows the Registrant of a Metering System to apply for a Metering Dispensation if, for financial or practical reasons, Metering Equipment will not or does not comply with some or all the requirements of a CoP.
- 1.3 The process for applying for a Metering Dispensation is set out in [BSC Procedure \(BSCP\) 32 'Metering Dispensations'](#).

2. Background to D/490

- 2.1 In October 2009, National Grid Interconnectors Limited (NGIC) applied for a lifetime Metering Dispensation (D/358) against [CoP1](#) 'Code of Practice for the metering of circuits with a rated capacity exceeding 100MVA for Settlement purposes' to use non-standard Fibre Optic Current Transformers (FOCTs), instead of wire wound (i.e. inductive) CTs, on the DC side of the Anglo France Interconnector (IFA) at the Sellindge AC to DC converter station.
- 2.2 The IFA consists of four poles or two bipoles (BP1 and BP2). Poles 1 and 2 are associated with BP1 and poles 3 and 4 with BP2. Each pole is capable of conveying up to 500MW of power in either direction (Import or Export). The signals from the FOCTs (main and check) on each pole are fed via interface cards, along with signals from the voltage dividers (main and check) on each pole, to the DC Meters (main and check).
- 2.3 The table in Appendix 1 represents a summary of the original Metering Dispensation application (D/358) and subsequent applications relating to the use of the FOCTs associated with the IFA Metering System.

ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

3. Metering Dispensation D/490

- 3.1 In September 2018 NGIC applied for a Metering Dispensation (D/490) from CoP1 to continue using the FOCTs installed at the Sellindge (AC/DC) converter station (Attachment A).
- 3.2 NGIC requested a permanent Metering Dispensation for the FOCTs, including an obligation on them to carry out four yearly calibration checks of the FOCTs (including the DC offsets) on all four poles in association with their Meter Operator Agent (MOA).
- 3.3 At its meeting ([ISG210/05](#)) on 23 October 2018, the ISG approved D/490 on a lifetime basis subject to the following condition:
- NGIC tests both poles of one of the bipoles in 2019 and then on a four-yearly basis;
 - NGIC tests both poles of the other bipole in 2021 and then on a four-yearly basis;
 - NGIC reports to the ISG in October 2021 with the results of the testing on both bipoles and then on a four-yearly basis;
 - if any test results show the errors of the FOCT outputs have drifted outside (if not already) or further outside (if already) IEC 60044-1 or CoP1 accuracy limits, then NGIC are to adjust and recalibrate the impacted FOCTs and report to the ISG within two months of doing so; and
 - NGIC monitors the Imports (and Exports) across the interconnector monthly, on a rolling six month basis, and reports the number Settlement Periods below 100MW, expressed as a percentage of the total number Settlement Periods in that rolling six month period, monthly to the ISG Secretary. If that number exceeds 1%, the ISG Secretary will report this (via a verbal update) to the ISG.

4. Update on condition attached to D/490

Monthly 'below 100MW' reports

- 4.1 Since the ISG approved D/490 NGIC has provided monthly reports to ELEXON, showing the number of Settlement Periods below 100MW, expressed as a percentage of the total number Settlement Periods in a rolling six month period (Attachment B).
- 4.2 The report shows that although the percentage figure was initially just greater than 1% (i.e. 1.01%) for the '01.09.18 to 01.02.19' six month period, the trend has been downward suggesting that the poles tend not to operate below 100MW very often and are doing so less often.

FOCT Calibration reports

- 4.3 In April 2019 NGIC's MOA (Siemens) carried out routine FOCT calibration tests on bipole 2 (Attachment C).
- 4.4 The report concludes that:
- the stability of the DC offset continues to provide issues at the lower end of the load curve.
 - the scale factor which predominates at the higher end of the load curve continues to provide very good stability.
- 4.5 The report goes on to say that although the offset on the pole 4 check FOCT was adjusted, the largest drift was on the pole 3 check FOCT with a large swing from negative to positive and that if this level of drift continues in the same direction, this will require adjustment at the next calibration.
- 4.6 Siemens suggest that if the FOCTs are left unadjusted, most of the DC offsets are pushing the design limits which in turn impact the lower end of the load curve. However, the materiality of this is considered to be low given that the converter station operates infrequently at this low level.

ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

Metering stability analysis

- 4.7 In August 2019 NGIC submitted a metering stability analysis to ELEXON (Attachment D).
- 4.8 NGIC compared main and check metered data on all the poles. The table titled 'Main vs Check 2' shows that pole 3 has the largest consistent discrepancy between main and check metered data and this in the region of about 0.5MWh. Pole 3 also has some sporadic issues which result in large discrepancies between the main and check metered data, the largest being 140MWh (see Main vs Check 1 table).
- 4.9 Since it is not clear from a main/check comparison which metered data is the 'accurate' metered data and because each pole of a bipole tends to carry the same power at the same time (except if one of those poles is on outage), NGIC also compared main metered data for pole 3 to main metered data for pole 4. NGIC concludes that it is the pole 3 check metering that is inaccurate, not the main metering. NGIC suspects this is as a result of an intermittent issue with a voltage divider. Fortunately, pole 3 check metered data is not settled unless there is a problem with the pole 3 main metering. NGIC says that a new solution will be needed to cover this eventuality.
- 4.10 NGIC also concludes that pole 1 main or check metering may be drifting, but to a lesser extent, with an average of 0.25MWh between them.
- 4.11 NGIC therefore intends to monitor all eight metering subsystems on a monthly basis to ensure metered data accuracy remains in line with BSC requirements. It will also look into options for a longer term resolution to the accuracy and drift problems seen with its metering solution.
- 4.12 According to NGIC, Siemens is due to calibrate the DC Meters in 2020.

5. ELEXON's view

- 5.1 ELEXON is very concerned that the pole 3 check metering is showing such large differences compared to the pole 3 main metering and contacted NGIC to ask it to:
- immediately investigate this; definitively identify the root cause; and report back to the ELEXON in January 2020; and
 - put forward options for a longer term solution to the accuracy and drift problems seen with its metering solution at the ISG meeting in February 2020.
- 5.2 NGIC confirmed:

Monthly monitoring of the eight pole Meters

- 5.3 It has made contact with IMServ (the data collector for the Central Data Collection Agent) and has started to receive metered data for all four poles' main and check Meter outputs. It will run a monthly version of the report it devised, using the previous two month's data (to ensure 100% overlap of data). This report will allow it to check each of the pole Meters against the other pole Meter and each of main and check pole Meters against the adjacent pole Meters. It confirmed the initial data tranche from IMServ up to 22nd September has shown very similar results as those identified for the 18 months to July 2019 in its ISG report (Attachment B).

Pole 3 check variations

- 5.4 Its intention to use the data tranche described above to drive a monthly report run that will allow it to correlate what physical and/or operational conditions are present on the IFA1 cross channel link at any time a significant drift is shown by the monthly data report. It intends to start to identify whether the sporadic drift seen on the pole 3 check Meter is actually derived due to output issues associated with the pole 3 check

ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

voltage divider, or whether some other issue is presenting itself. It has a control room manned 24/7/365 and therefore has the ability to tie in the data from the report to the data from its plant monitoring alarm systems, which will allow it to home in on the cause of this pole 3 check Meter issue, or indeed any other issue that may be indicated from the monthly report. It is not in NGIL's interest to leave a significant issue on pole 3 check Meter, as any failure of pole 3 main Metering System would oblige it to ask our Meter Operator to change the main Meter records from pole 3 main to pole 3 check and if this was still known to be faulty at that time will force it to remove 500MW of capability on pole 3 whilst it fixes the pole 3 check Meter error. NGIC will use the monthly data to drive its investigation so that during April 2020 bipole 2 outage it can correct the pole 3 check Meter discrepancy excursion issue.

General drift limitations

- 5.5 It has had assurances from its FOCT supplier (GE) that the drift, whilst close to the BSC limits at 5% power flows will not affect the metered data at higher power flows. NGIC's intention to monitor the eight Meters between the same pole outputs and across similarly loaded poles (per bipole) will allow it to understand whether the FOCT drift is only significant at low power flows. If there is any risk to the accuracy of the FOCT's outputs being affected at loads at or above 10% by offset drift (or any other metering subsystem drift identified by the monthly reporting process), then it will consult with the manufacturer to undertake changes to ensure the long term stability of the FOCT outputs.
- 5.6 NGIC are happy to share the monthly reports with the ISG or can submit a summary report in January 2020 with any potential actions its plans to enact during the BP2 outage in April 2020.
- 5.7 It is also NGIC's intention that any issues identified as needing implemented on BP2 will be included in any changes / recalibrations on BP1 during the September 2020 outage regardless of the Dispensation D/490 requirement to calibrate the BP1 FOCTs in 2021.
- 5.8 ELEXON recommends that NGIC submits a summary report to ELEXON in January 2020 with any potential actions it plans to enact during the BP2 outage in April 2020.
- 5.9 ELEXON will present the above information to the ISG at its February 2020 meeting.

6. Recommendations

- 6.1 We invite you to:
 - a) **NOTE** NGIC's report on the number of Settlement Periods below 100MW on the Anglo French Interconnector (IFA);
 - b) **NOTE** NGIC's report on the routine Calibration of the FOCTs for bipole 2;
 - c) **NOTE** NGIC's analysis on the Sellindge IFA metering stability; and
 - d) **NOTE** that ELEXON recommends that NGIC submits a summary report to ELEXON in January 2020 with any potential actions it plans to enact during the BP2 outage in April 2020; and
 - e) **NOTE** that ELEXON will present the above information to the ISG at its February 2020 meeting.

Appendices

Appendix 1 – Summary of Metering Dispensation extensions related to original application (D/358)

Attachments

Attachment A – Metering Dispensation application D/490

ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

Attachment B – Report on number of Settlement Periods in a rolling six month period flowing on IFA that are below 100MW

Attachment C (CONFIDENTIAL) – Sellindge FOCT routine calibration bipole 2 (April 2019)

Attachment D – Sellindge IFA metering stability analysis

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ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

Appendix 1 – Summary of Metering Dispensation extensions related to original application (D/358)

Dispensation Reference No.	Application Date	Reason/Requested Dispensation Term	ISG Meeting	ISG Paper No.	Outcome/Term Agreed	Reason/Conditions
D/358	Oct 2009	Use optical CTs instead of wound CTs on BP1 and BP2 for the IFA/Lifetime Evidence supporting the long term accuracy, stability and reliability of the optical CTs provided plus MDRG comments on the evidence/Lifetime Project programme delayed by 16 months – extension requested/ 16 months until April 2013 to gather evidence that the optical CT are functioning as expected	Nov 2009 Dec 2009 Aug 2011	ISG106/03 ISG107/04 (verbal update) ISG127/06	Deferred/- Approved/ Two years expiring 21 December 2011 Approved/16 months until April 2013	ISG requested the applicant provides evidence supporting the long term accuracy, stability and reliability of the optical CTs and for MDRG to review it/- Two years granted as application is based on relatively new technology/ISG noted that the applicant should provide clear and comprehensive evidence that the optical CT are functioning as expected when renewing the Metering Dispensation -/-
D/389	Nov 2012	BP1 CTs tested in October 2012 (after 17 months in service). 3 out of 4 showed small offset drifts affecting errors at low loads (drifts corrected and CTs recalibrated). Request to extend the Metering Dispensation for another year so further data can be gained by re-testing BP1 (and BP2) CTs in 2013 and a suitable test program can be established for this type of CT and also to consider any changes to any equipment in the metering chain/One year	Jan 2013	ISG141/01	Deferred/-	ISG requested the applicant come back with a plan to resolve the issues and requested that this be submitted to ELEXON by the February 2013 ISG meeting or the March 2013 ISG meeting at the latest/-

ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

		NGIC provided a plan: 'carry out further testing on the meter circuits at the next available opportunity. For BP2 this will be in the next two months. Investigation into the components on circuit boards to identify any potential problems. Once this is complete full review of results and decision taken on whether a new design is required. All parties are happy with the optical CT's, the focus is on the interface electronics' /One year	Mar 2013	ISG143/04	Approved/Six months until 30 October 2013	-/Subject to the test results for BP2 being reported to the ISG once testing was completed and the results have been evaluated by the equipment supplier
D/414	Aug 2013	BP2 CT tests in June 2013 showed some offset drift. New interface card designed with dedicated channels, fewer electronic interfaces and high accuracy components. Applicant plans to install the new interface cards on the BP1 circuits in October 2013 and add a new outage to BP2 in March 2014 to install new interface cards on the BP2 circuits. Request for extension to install and re-test CTs/18 months until 30 April 2015 NGIC provided an updated plan: install new interface cards on BP1 circuits in Oct 2014; seek an extension to D/414 to enable it to retest the CTs and new interface cards after a year in service to get longer term stability data to back up its initial test data which suggested performance within the specified limits; retest BP2 CTs (with the new interface cards) in Mar 2015; retest the BP1 CTs (with the new interface cards) in Oct 2015; and because NGIC has some work to undertake on the AC connections (currently in 2016/17) they are planning to put in facilities to enable conventional AC metering to be installed	Sept 2013 April 2014	ISG149/03 ISG156/03 (Confidential)	Approved/12 months until 30 September 2014 The ISG agreed to amend D/414 to include NGIC's updated plan/-	The ISG approved D/414 for 12 months in order to see the test results earlier. ELEXON agreed to provide an update on testing in April 2014/- NGIC had not stuck to the plan detailed in D/414/ISG noted that NGIC should apply for an extension to D/414 in time for the July 2014 ISG meeting

ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

D/427	May 2014	Due to manufacturing problems the supplier of interface cards was unable to deliver in time for the October 2013 outage (BP1). The supplier did modifications in time for BP2 in March 2014. Therefore 6 month delay. NGIL also confirmed it plans to set up a replicated test bed/15 months	July 2014	ISG159/05 (Confidential)	Deferred/-	The ISG deferred a decision until more details are provided on the test bed and any initial test results.
		ELEXON requested further detail from NGIC in mid-Aug 2014 and early Sept 2014. NGIC suggested a test regime but could not provide test results from the test bed. In early Sept 2014 it was still struggling to get the test bed set up. ELEXON noted at the ISG meeting that the applicant had just confirmed that there should be test results from the new test bed in the next two weeks. BP2 test data provided showed magnitude and drift of the output offset (i.e. zero load output) has been significantly improved on the revised cards. However, there would appear to be a temperature dependency within the optical CT head that requires further investigation and characterisation	Sept 2014	ISG161/06 (Confidential)	Approved/ Until 30 December 2015	-/NGIC provides copies of all test reports (and results) from testing the new interface cards to ELEXON as soon as the tests are completed so that these can be reviewed by ELEXON and the MDRG
D/454	July 2015	NGIC confirmed BP2 CTs tests show errors are within IEC 60044-1 standard limits. Request for a two year extension (end of Dec 2017) to investigate possible voltage divider circuit errors (detected as part of a Trading Dispute) and calibrate voltage dividers (using 150kV voltage source). CoP1 overall accuracy limits maintained despite voltage divider errors.	Sept 2015	ISG173/02	Approved/Until 30 December 2017	-/ The applicant provides a detailed plan for fixing the possible voltage divider circuit errors (detected as part of a Trading Dispute). Report from NGIC provided in Aug 2016. NGIC has decided to: install revised and stabilised power supplies; install new CAPSU CT heads; and calibrate the voltage dividers in outages in Sept 2016 (BP2) and Oct 2016 (BP1).

ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

D/480	Sept 2017	<p>NGIC: calibrated the optical CT outputs and, where necessary, corrected offset drifts and then recalibrated the optical CT outputs, at each BP outage; tested the voltage dividers and confirmed all the voltage dividers were found to be well within the specified accuracy requirements of CoP1 for wound voltage transformers; made refinements to the optical CT connections and screening during the BP1 and BP2 outages; following an investigation of the BP1 'As Found' 5% load point error, used the remaining part of the BP1 outage to begin to study the DC Meter offset, which was seen to be the cause of the error at low load points. NGIC proposed to measure and record the offset voltages of both the main and the check DC Meter inputs of any pole CTs at every opportunity throughout 2018 when either the BP1 or BP2 circuits are off load for more than 30 minutes (to ensure a representative set of readings are collected). From this NGIC will then be able to: understand whether the offset is stable or suitably stable; and pass the offset data to the ISG. NGIC also plan to re-check, witness and record the "As Found" results for the BP1 and BP2 optical CTs during its planned outages in 2018. NGIC will report back to the ISG with these results, along with the DC Meter offset readings in October 2018.</p> <p>Cont'd...</p>	Dec 2017	ISG200/06	Approved/Until 30 December 2018	-/Subject to NGIC provides the following information to the ISG at its meeting in October 2018: the results of the 'As Found' testing of BP1 and BP2; the results of the offset testing; and the proposed plan to ensure a final accurate DC (or AC) metering scheme.
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ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

		<p>NGIC will present its preferred solution to the ISG for approval in October 2018:</p> <p>Option A: Request the MOA to compensate the offset within the DC Meters for each of the main and check DC Meters on all four poles (if the BP1 and BP2 optical CT output 'As Found' results are stable compared to the 2017 results and the measured offset results, at 0MW load on the two BP circuits, show stability in the millivolt readings taken during 2017-18). Budget cost = £5,000; Completed by the end of 2018.</p> <p>Option B: Install new optical CT's with a lower ratio i.e. equivalent to 4000/2000-1 not 20,000-1. Using lower ratio optical CTs will improve the resolution of their output (x5/x10) meaning small offset drifts will have less impact on accuracy at low loads (if results are not stable in comparison to the 2017 results. These new CT's will be used solely for metering purposes). Budget cost = £300,000 - £500,000; Completed by the end of 2019.</p> <p>Option C: Install AC metering at each of the BP AC Connections. This would utilise air insulated CT/VT equipment and would need a Metering Dispensation request for a small correction factor incorporated in the metering outputs to allow for the CT/VT units not being installed at the Boundary Point (BP) connection point to the NGET 400kV system. Budget cost = £800,000 - £1,500,000; Completed by the end of 2019.</p> <p>Cont'd...</p>				
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ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

		Option D: Install new AC CTs in the SF6 Switchgear CTs at the NGIC Connection points for each BP in the NGET 400kV substation. Budget cost = £3,000,000 - £4,000,000; Completed by the end of 2020-21.				
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ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

D/490	Sept 2018	<p>The results of the 2018 'As found' tests show that there is still a minor error (i.e. the error is outside IEC 60044-1 limits) on the accuracy of the current metering solution at loads under 100MW (i.e. below 20% rated current) whilst the Interconnector is importing only. Using a materiality figure of £50/MWh NGIC estimates that the total error, at loads below 100MW, for 2017 is £4,800 and, for 2018 (to May), this figure is as low as £700. NGIC believes that, although the level of below 100MW flows may vary year on year, the increase and reliance of renewables on the Grid should mean that flows below 100MW will become more infrequent.</p> <p>The FOCT errors are impacting the overall accuracy of the main Settlement Meter readings (only) for poles 1 and 2, at low loads - i.e. at 5% (25MW) rated current, for pole 1, and at 5% and at 10% (50MW) rated current, for pole 2. Below 5% rated current, for pole 1, and below 5% and above 5% and below 10% rated current, for pole 2, the errors are within CoP1 overall accuracy limits. The check Settlement Meter readings for poles 1, 2, 3 and 4 are within CoP1 accuracy limits at all loads.</p> <p>NGIC acknowledge that although the error identified on the FOCTs is outside the tolerance set under the BSC, it believes the significance to be minor, particularly in the context of the overall metering solution and operation of the Interconnector.</p> <p>Therefore, NGIC believes it not to be cost-effective to</p>	Oct 2018	ISG210/05	Approved/Lifetime	<p>-/Subject to the following condition:</p> <p>NGIC tests both poles of one of the bipoles in 2019 and then on a four-yearly basis;</p> <p>NGIC tests both poles of the other bipole in 2021 and then on a four-yearly basis;</p> <p>NGIC reports to the ISG in October 2021 with the results of the testing on both bipoles and then on a four-yearly basis;</p> <ul style="list-style-type: none"> if any test results show the errors of the FOCT outputs have drifted outside (if not already) or further outside (if already) IEC 60044-1 or CoP1 accuracy limits, then NGIC are to adjust and recalibrate the impacted FOCTs and report to the ISG within two months of doing so; and NGIC monitors the Imports (and Exports) across the interconnector monthly, on a rolling six month basis, and reports the number Settlement Periods below 100MW, expressed as a percentage of the total number Settlement Periods in that rolling six month period, monthly to the ISG Secretary. If that number exceeds 1%, the ISG Secretary will report this (via a verbal update) to the ISG.
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ISG222/04 - METERING DISPENSATION D/490 (SELLINDGE) – UPDATE ON CONDITION

		<p>implement a DC (or AC) metering solution at the cost of millions of pounds.</p> <p>NGIC therefore requests permission from the ISG for a permanent Metering Dispensation for the FOCTs, including an obligation on NGIC to carry out four-yearly calibration checks of the FOCTs (including offset testing) on all four poles in association with its Meter Operator Agent (MOA).</p>				
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