ELEXON

# CP Assessment Report

# CP1586 ‘Defining the Requirements for Minimum Burden and CT ratios’

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## About This Document

You can find the definitions of the terms and acronyms used in this document in the BSC Glossary[1].

This document is the Change Proposal (CP) Assessment Report for CP1586 which Elexon will present to the SVG and the ISG at their meetings on 9 January 2024. The Committee(s) will consider the proposed solution and the responses received to the CP Consultation before making a decision on whether to approve CP1586.

There are four parts to this document:

- This is the main document. It provides details of the solution, impacts, costs, and proposed implementation approach. It also summarises the SVG and ISG’s initial views on the proposed changes and the views of respondents to the CP Consultation.
- Attachment A contains the CP proposal form.
- Attachment B contains the proposed redlined changes to deliver the CP1586 solution.
- Attachment C contains the full responses received to the CP Consultation.

**Committee**

Imbalance Settlement Group (ISG) and Supplier Volume Allocation Group (SVG)

**Recommendation**

Approve

**Implementation Date**

29 February 2024

(February 2024 Release)

**Contact**


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[1] https://www.elexon.co.uk/glossary/?show=all

# 1. Summary

## Why change?

In some cases, the Current Transformer (CT) ratio for the maximum current of the circuit is not appropriately selected, even though these ratios are vital for accurate energy settlement as they ensure safe and precise current conversion, maintain metering equipment within its optimal operating range, and uphold regulatory compliance standards.

This oversight  becomes particularly problematic when the load conditions of a circuit typically operate below 1% of the rated primary current (Ir), compromising the accuracy of the Active Energy data. This could lead to miscalculations in energy billing, discrepancies in energy consumption records, and potential challenges in balancing supply and demand for Active Energy. Furthermore, there are cases where Metering Systems function outside the specified error limits or stray from the 25%-100% rated burden range, introducing potential inaccuracies into the system, which could also lead to inaccurate billing.

## Solution

CP1586 will amend Codes of Practice (CoPs) 1: The Metering of Circuits with a Rated Capacity Exceeding 100 MVA for Settlement Purposes[2], Code of Practice 2: The Metering of Circuits with a Rated Capacity not Exceeding 100 MVA for Settlement Purposes[3], Code of Practice 3: The Metering of Circuits with a Rated Capacity not Exceeding 10 MVA for Settlement Purposes[4], and Code of Practice 5: The Metering of Energy Transfers with Maximum Demand of up to (and Including) 1MW for Settlement Purposes[5] to establish specific criteria for selecting appropriate CT ratios and setting boundaries for load conditions. This ensures that the Metering System's overall accuracy remains within the specified limits set out in the CoPs.

CP1586 will also clarify the need to choose a suitable rated value of primary current for the CT, ensuring that the Rated Measuring Current neither falls below 1% nor exceeds 120% under all running conditions. Additionally, CP1586 specifies that designers can add an additional burden to the secondary side of the measurement transformers, helping to maintain the overall accuracy of energy measurements. This adjustment ensures the total burden stays within the 25% to 100% range of the rated output, in line with the limits of ratio error and phase displacement specified in the relevant standards (BS EN/IEC 61869-2[6] for CTs and BS EN/IEC 61869-3[7] for Voltage Transformers (VTs)).

As a result of the CP1586 Consultation, Code of Practice10: The Metering of Energy via Low Voltage Circuits for Settlement Purposes [8] has also been added to this solution.

**Not sure where to start?**

We suggest reading the following sections:

- Have 5 minutes? Read section 1
- Have 15 minutes? Read sections 1, 4, 5 and 6
- Have 30 minutes? Read all sections
- Have longer? Read all sections and the annexes and attachments

**What is a CT?**

A Current Transformer (CT) is a device used to transform high currents from power lines into a lower, measurable current for safety and accurate measurement purposes.

**What is a CT ratio?**

The CT ratio represents the relationship between the primary current input and the secondary current output. For example, a CT ratio of 1000:1 means that when 1000 amperes flow through the primary winding, 1 ampere will flow through the secondary winding, which is used for measurement and monitoring.

[2] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice-1-the-metering-of-circuits-with-a-rated-capacity-exceeding-100-mva-for-settlement-purposes
[3] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice-2-the-metering-of-circuits-with-a-rated-capacity-not-exceeding-100-mva-for-settlement-purposes
[4] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice-3-the-metering-of-circuits-with-a-rated-capacity-not-exceeding-10-mva-for-settlement-purposes
[5] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice-5-the-metering-of-energy-transfers-with-maximum-demand-of-up-to-and-including-1mw-for-settlement-purposes
[6] https://webstore.iec.ch/publication/6050
[7] https://webstore.iec.ch/publication/6051&preview=1
[8] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice10-the-metering-of-energy-via-low-voltage-circuits-for-settlement-purposes


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## Impacts and costs

CP1586 will require changes to Codes of Practice (CoPs) 1, 2, 3 and 5. The central implementation cost will be less than £2K to make the relevant document changes.

There is no anticipated impact on Parties or Party Agents as a result of this change. A respondent did mention a high impact as a result of CP1586. This is discussed further in Section 7.
However, there is the overall benefit of enhancing the accuracy and reliability of energy settlements and ensuring consistent compliance with established standards. No BSC central systems changes are anticipated.

## Implementation

CP1586 is proposed for implementation on 29 February 2024 as part of the Standard February BSC Release.

## Recommendation

We invite the **SVG** and **ISG** to:

- **AGREE** the proposed changes to the redlining for Codes of Practice (CoPs) 1, 2, 3 and 5 and addition of proposed redlining for CoP 10 for CP1586 made following the CP Consultation;
- **APPROVE** the proposed changes to Codes of Practice (CoPs) 1, 2, 3 and 5 for CP1586;
- **APPROVE** CP1586 for implementation on 29 February 2024 as part of the standard February 2024 Release; and
- **NOTE** that CP1586 will also be presented for decision to the
    - SVG on 9 January 2024; and
    - ISG on 9 January 2024.


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## 2. Why Change?

### What is the issue?

In energy settlement, the selection of CT ratios plays a pivotal role by determining the accuracy of current measurements. A correctly chosen CT ratio ensures that high currents from power lines are transformed to a level that Metering Equipment can safely and accurately measure.

This precise conversion is essential for reliable energy data, which forms the basis for fair billing, regulatory compliance, and efficient energy distribution and management. However, a recurring issue arises when designers of Metering Systems don't select these ratios with the maximum current of the circuit in mind. Designers could be Equipment Owners; e.g Licensed Distribution System Operators (LDSOs) or Meter Operator Agents (MOAs).

This oversight doesn't only represent a procedural lapse; it also impacts the integrity of the energy settlement process. The CT ratios, designed to ensure precise measurements, lose their efficacy when mismatched with the circuit's current. As a result, the very foundation of energy data accuracy becomes unreliable, as the transformed currents no longer reflect the actual conditions of the circuit, leading to potential discrepancies in Settlement.

The situation exacerbates when the load conditions of a circuit hover below 1% of the rated primary current (Ir). At such low levels, the CT may not operate within its optimal accuracy range, potentially introducing errors into the measurements and making it challenging to capture precise energy consumption or production values. It's not only about slight discrepancies in numbers; it's about ensuring the reliability and consistency of the entire energy settlement process.

Another layer of complexity is added when Metering Systems operate outside their designated parameters. Specifically, when these systems don't adhere to the specified error limits or deviate from the 25%-100% rated burden range, it's a clear indication of potential inaccuracies. Such deviations can't be brushed off as minor technical glitches. They represent systemic issues that can compromise the integrity of the energy settlement process, necessitating immediate attention and rectification.

### Background

CP1586 originates from Aspect 17 ‘Minimum burden requirement and CT ratio vs circuit/agreed capacity’ of Issue 93 ‘Review of the BSC Metering Codes of Practice’[9] which sought to review the BSC Metering Codes of Practice. Meter Operator Agents who attended the Issue group believed they would benefit from improvement and/or clarification on a number of aspects to be identified and confirmed by this Issue.

#### What is Issue 93?

The Association of Meter Operators (AMO)[10] raised Issue 93 on 15 January 2021 to review the metering Codes of Practice (CoPs), which have never been reviewed in totality before. The main aim of the review was to improve the CoPs, and where appropriate, remove existing perceived ambiguities and obsolete processes and technology.

The Workgroup discussed the appropriate CT ratio to specify, what minimum burden needed to be specified in the CoPs, what the overall accuracy limits should be for where prevailing conditions are outside of the limits specified in the relevant CoPs, and if changes

[9] https://www.elexon.co.uk/smg-issue/issue-93/
[10] https://meteroperators.org.uk/


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to the CoPs should be limited to CoPs 1, 2, 3, 4, 5 and 10. In conclusion, Elexon provided the below recommendations to the Workgroup:

For minimum burden:

- Add text to the relevant CoPs to provide guidance on what factors need to be considered for choosing a typical burden for Settlement purposes; and
- Align across the CoPs that additional burden can be added to maintain overall accuracy.

For CT ratios:

- CTs should be assigned a 'S' accuracy class (e.g. 0.5S); and

A cautionary text will be added to the relevant CoPs to advise where a site can operate outside of specified limits the designer of the Metering System or Registrant should satisfy themselves that Overall Accuracy is still maintained.

The Workgroup noted and agreed to the recommendation. Elexon confirmed that a CP will be raised after the Issue 93 review concludes, to reflect the recommendation.

The recommendations were presented to, and noted by, the BSC Panel on 8 September 2022 (330/08)[11].

**What is Minimum Burden?**

In the context of CTs, the minimum burden refers to the lowest amount of impedance or load that can be connected to the secondary winding of the transformer while still ensuring that the transformer operates within its specified accuracy limits. It's

[11] https://www.elexon.co.uk/meeting/bsc-panel-330/


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# 3. Solution

## Proposed solution

To address the identified issues, Elexon proposes specific amendments to the CoPs 1, 2, 3, and 5. The primary focus is on refining the guidelines to ensure the Metering System's accuracy remains consistent under all operating conditions.

Firstly, paragraph 4.3.1 of CoPs 1, 2, 3, and 5 will be revised to offer explicit guidance on evaluating the full range of operating conditions. This ensures that the overall accuracy of the Metering System adheres to the specified limits, irrespective of any variations in operational conditions.

Secondly, paragraph 5.1.1 in CoPs 1, 2, 3, and 5 will be clarified to emphasise the importance of selecting an appropriate rated value of primary current for the CT. The objective is to guarantee that the Rated Measuring Current, when expressed as a percentage, remains within a range of 1% to 120% across all operational scenarios. This is not merely a procedural adjustment but a critical step to ensure the CT, one of the core components of the Metering System, operates at its optimal efficiency.

Lastly, paragraphs 5.1.1 and 5.1.2 in CoPs 1, 2, 3, and 5 will be updated to address the burden in measurement transformers. The amendments will specify that, if required, an additional burden can be incorporated on the secondary side of these transformers. This ensures the overall accuracy of energy measurements by aligning the total burden within the 25% to 100% range of the rated output. This alignment is in accordance with the limits of ratio error and phase displacement as specified in the relevant standards, namely BS EN/IEC 61869-2 for CTs and BS EN/IEC 61869-3 for VTs.

After the CP Consultation, CoP 10 was also included in the solution of CP1586. Paragraph 5.1 in CoP 10 will be clarified to emphasise the importance of selecting an appropriate rated value of primary current for the CT. The objective is to guarantee that the Rated Measuring Current, when expressed as a percentage, remains within a range of 1% to 120% across all operational scenarios. This is not merely a procedural adjustment but a critical step to ensure the CT, one of the core components of the Metering System, operates at its optimal efficiency.

Paragraphs 5.1 in CoP 10 will be updated to address the burden in measurement transformers. The amendments will specify that, if required, an additional burden can be incorporated on the secondary side of these transformers. This ensures the overall accuracy of energy measurements by aligning the total burden within the 25% to 100% range of the rated output.

## Proposer’s rationale

The essence of these proposed changes is to instil a greater degree of clarity and precision in the energy settlement process. By offering clear guidelines on the appropriate CT ratios and rated burdens for Metering Systems, this promotes not just adherence to best practices but actively enhancing the reliability of the entire system as it ensures consistent accuracy in energy measurements. When LDSOs and MOAs have a clear roadmap, the likelihood of errors diminishes.
For instance, without proper guidance, they might select inappropriate CT ratios that don't match the circuit's maximum current, leading to inaccurate energy measurements. They could also miscalculate the required burden for measurement transformers, causing the system to operate outside its optimal accuracy range. Additionally, without a clear understanding of the standards, there's a risk of non-compliance with regulatory requirements, which can result in financial penalties and reputational damage.


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Additionally, by providing guidance on handling situations where operating conditions might deviate from the norm, we are equipping LDSOs and MOAs with the tools and knowledge to navigate such scenarios effectively, ensuring that the integrity of the energy settlement remains uncompromised.

## Proposed redlining

The CP proposes to update Codes of Practice (CoP) 1, 2, 3, 5and 10. The redlining to support this change can be found in Attachment B.

# 4. Impacts and Costs

## BSC Party & Party Agent impacts and costs

CP1586 is considered to be a document only change and does not materially impact any BSC Party or Party Agent. There are also no anticipated impacts on any BSC systems.

| BSC Party & Party Agent Impacts | |
|---|---|
| BSC Party/Party Agent | Impact |
| N/A | N/A |

## Central impacts and costs

### Central impacts

The solution in CP1586 only affects BSC documentation. No BSC Central Systems or Agents will be impacted.

| Central Impacts | |
|---|---|
| Document Impacts | System Impacts |
| • Code of Practice 1 'The Metering of Circuits with a Rated Capacity exceeding 100MVA for Settlement Purposes'[12]<br>• Code of Practice 2 'The Metering of Circuits with a Rated Capacity not exceeding 100MVA for Settlement Purposes'[13]<br>• Code of Practice 3 'The Metering of Circuits with a Rated Capacity | • None |

[12] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice-1-the-metering-of-circuits-with-a-rated-capacity-exceeding-100-mva-for-settlement-purposes
[13] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice-2-the-metering-of-circuits-with-a-rated-capacity-not-exceeding-100-mva-for-settlement-purposes


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| | |
|---|---|
| not exceeding 10MVA for Settlement Purposes'[14]<br>• Code of Practice 5 'The Metering of Energy Transfers with Max Demand of up to (and including) 1MW for Settlement Purposes'[15]<br>• Code of Practice10 'The Metering of Energy via Low Voltage Circuits for Settlement Purposes'[16] | |

## Impact on BSC Settlement Risks

| Impact on BSC Settlement Risks |
|---|
| CP1586 is anticipated to have a positive impact on reducing Settlement Risks. By reducing the instances of the selection of an inappropriate current transformer ratio that would impact overall accuracy and as a result Settlement accuracy. |

## Impact on Market-wide Half Hourly Settlement (MHHS)

| Impact on MHHS |
|---|
| None |

## Central costs

The central implementation costs for CP1586 will be approximately less than £2K.

[14] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice-3-the-metering-of-circuits-with-a-rated-capacity-not-exceeding-10-mva-for-settlement-purposes
[15] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice-5-the-metering-of-energy-transfers-with-maximum-demand-of-up-to-and-including-1mw-for-settlement-purposes
[16] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice10-the-metering-of-energy-via-low-voltage-circuits-for-settlement-purposes


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# 5. Implementation Approach

## Recommended Implementation Date

CP1586 is recommended for implementation on 29 February 2024 as part of the standard February 2024 BSC Release.



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# 6. Initial Committee Views

## ISG's initial views

At its meeting on 7 November 2023 (271/05[17]) the ISG was invited to note the progression of the CP and provide any comments or additional questions for inclusion in the CP Consultation.

The ISG did not form a quorate committee and was therefore unable to meet to consider CP1586. As the purpose of the presentation was for information only (no decision required), CP1586 will continue to the consultation phase. Members have been invited to give their views on the CP1586 via email and any late feedback can be considered at the January meeting, when the ISG will be invited to come to a decision on CP1586.

## SVG's initial views

At its meeting on 7 November 2023 (273/04[18]) the SVG was invited to note the progression of the CP and provide any comments or additional questions for inclusion in the CP Consultation.

An SVG member asked why the solution had not included CoP 10. Elexon explained that CP1586 originated from Issue 93 and the opinion of the group was that the main issues were in CoPs 1, 2, 3 and 5 Metering Systems. Elexon acknowledged that CoP10 installations do have Current Transformers, albeit in much lower volumes than Whole Current installations. The SVG member said this would still be worth including in the CP Consultation, Elexon agreed to add a question on whether CoP10 should be included as part of the CP solution.

The SVG made no further comments and only provided one additional consultation question in regards to CoP10.

[17] https://www.elexon.co.uk/meeting/isg271/
[18] https://www.elexon.co.uk/meeting/svg273/


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## 7. Industry Views

This section summarises the responses received to the CP Consultation. You can find the full responses in Attachment C.

| Summary of CP1586 CP Consultation Responses | | | | |
|---|---|---|---|---|
| Question | Yes | No | Neutral/No Comment | Other |
| Do you agree with the CP1586 proposed solution? | 3 | 2 | 0 | 0 |
| Do you agree that the draft redlining delivers the intent of CP1586? | 4 | 1 | 0 | 0 |
| Will CP1586 impact your organisation? | 4 | 0 | 1 | 0 |
| Will your organisation incur any costs in implementing CP1586? | 3 | 0 | 2 | 0 |
| Do you agree with the proposed implementation approach for CP1586? | 4 | 1 | 0 | 0 |
| Do you believe CoP10 should be incorporated into the scope of CP1586 for Metering Systems using Current Transformers? | 2 | 1 | 2 | 0 |
| Do you have any further comments on CP1586? | 2 | 1 | 2 | 0 |

One respondent expressed reservations about CP1586, acknowledging the proposal's rationale but highlighting its limitations in completely eliminating inaccuracies at low load levels. They pointed out that it's not always possible to ensure the load remains above 1% of the rated current, citing the example of an unused building with minimal lighting, which could fall below this threshold. The respondent suggested that the objective should be to minimise instances where the percentage of rated measuring current falls outside the 1% to 120% range, rather than trying to eliminate these occurrences entirely.

Elexon responded that the complete elimination of inaccuracies at low load levels is indeed challenging. They referenced the introduction of the ‘S’ class standards for CTs under CP1553, noting that the risk to Settlement when the load is below 1% primary current (Ir) is minimal. Elexon confirmed that a reference to ‘where reasonable practicable’ has been added into section 5.1.1 (Current Transformers) of the CoPs to provide mitigation for such scenarios as the example provided, where it is not practicable to always be within 1% Ir and 120% Ir. This amendment also provides consistency with the additions in section 4.3.1 (Overall Accuracy).

Elexon emphasised that the CP aims to provide guidance for scenarios where achieving the ideal CT ratio is impractical. They reassured that current meter designs should comply with overall accuracy requirements and that the CP is intended to add guidance and promote good industry practice. As there is no material change to current practices on overall accuracy, there is no reason to delay implementation.

Elexon highlighted the importance of the 'where reasonably practicable' approach, ensuring compliance with accuracy limits even in low load situations but only where it is reasonable to do so. An example highlighted was where a Metering System was designed for the rated Active Export and the site only imports very low levels of Active Energy Import.


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Another respondent raised concerns about the necessity of meeting the 25% burden limit stated in the CP, arguing that systems can comply with the accuracy requirements of the CoPs without necessarily being burdened to this extent. They highlighted that if a meter operator can verify the CT's accuracy within the working burden and provide documentation, imposing additional construction costs for creating the mandated burden, such as extensive multi-core cabling, is unnecessary. They also emphasised the importance of ensuring CT safety under fault conditions at the rated burden, suggesting that the 25% limit should be mandated only when other verification methods are not feasible.

In response, Elexon clarified that the redlining reflects that additional burden "can be added" but is not mandatory if overall accuracy has been proven without it. This approach aligns with the IEC standards, which specify tests at 25% and 100% burdens, and offers flexibility to MOAs in proving compliance. Elexon updated the redlining to add “for example” when adding additional burden.

Most of the respondents responded that the impacts of CP1586 would be low on their organisation.

Two respondents shared views that Code of Practice10: The Metering of Energy via Low Voltage Circuits for Settlement Purposes[19] should also be included in the CP1586 solution. Updated redlining is attached to reflect that. The rationale given by one of the respondents was “If the requirement is for all measuring devices to be ‘S’ class then yes it should apply to CoP10 as well. NGED already use ‘S’ class items at all voltages.”

[19] https://bscdocs.elexon.co.uk/codes-of-practice/code-of-practice10-the-metering-of-energy-via-low-voltage-circuits-for-settlement-purposes


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## 8. Recommendations

We invite the **SVG and ISG** to:

- **AGREE** the proposed changes to the redlining for Codes of Practice (CoPs) 1, 2, 3 and 5 and addition of proposed redlining for CoP 10 for CP1586 made following the CP Consultation;
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