

DATA INFORMATION COLLECTION PROCESS FOR THERMAL RATING SCHEDULES

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PURPOSE AND SCOPE

This procedure sets out the requirements, responsibilities and procedures for producing and submitting the Thermal Rating technical information to Electricity Transmission Asset Management (ETAM) to satisfy the requirements of AMPM 7301 Provision of Thermal Rating Sheets.

This procedure is to be adopted in the following circumstances:

- (a) Whenever a new circuit or item of substation plant is installed on the system or an existing item is replaced.
- (b) Whenever a complete or partial section of Overhead Line /Cable is installed, replaced or uprated.
- (c) Whenever protection equipment is replaced or whenever settings are changed on a relay.

PART 1 – PROCEDURAL

1 TIMESCALES

The timescales to be adhered to for the production of the Thermal Rating schedules are stated in UKBP/TP106, Equipment Commissioning & Decommissioning. The required timescales are as follows:

1.1 20+ Weeks Prior to Circuit Commissioning

The Contractor Design Approval Engineer shall produce the Thermal Protection Rating Data and Plant Rating Data forms for the circuit and equipment to be commissioned and send the completed forms to the Design Engineer (Assurance).

The Design Engineer (Assurance) must check the forms for accuracy and comment as necessary.

1.2 18 Weeks Prior to Circuit Commissioning

The Design Engineer (Assurance) shall issue the Thermal Protection Rating Data and Plant Rating Data forms by email to the ETAM, Thermal Ratings Engineers.

If the Design Engineer (Assurance) is not enacting the Commissioning Officer role on a project they must at this stage confirm to the Commissioning Officer that all Thermal Rating data is complete, it has been confirmed to be accurate and has been submitted to ETAM. Some projects may require multiple confirmations to the Commissioning Officer for differing equipment categories, for example from the Cable, OHL & HV Plant Design Engineers (Assurance).

2 SUBSTATION PLANT DATA

The form to submit plant data is illustrated in Appendix B. The purpose of this form is to convey details of the primary plant installed within any particular substation bay and its date of commissioning onto the Electricity Transmission System. The form identifies the equipment types to be installed and their nominal ratings. It is only necessary to state the equipment type, as the ETAM Thermal Ratings Engineers have a database of the full ratings schedules for every piece of type registered equipment.

The full & final arrangement showing any new or replaced equipment must be identified. There is no need to provide rating details of existing equipment other than identifying nomenclature changes as these will already be held in the CUP2 database. However it is helpful if a sketch of the single line diagram of the bay highlighting the changed equipment can be provided in the space provided. Alternatively a Single Line Diagram or an Operations Diagram with the changes highlighted should be provided.

3 OVERHEAD LINE DATA

The form to submit overhead line (OHL) data is illustrated in Appendix B. The purpose of this form is to list all details of any new / replaced sections of OHL. For completeness details of the existing sections should also be listed. It is important that the details of whether a section of line is brand new or existing, the type of surface treatment and the grease type are all stated. This is because these factors all affect the OHL's thermal rating and ETAM must be aware of them before producing the final rating schedule. Usually the replacement of overhead line fittings such as spacers does not cause an impact on existing thermal ratings and therefore such work does not require data to be submitted to ETAM.

4 SERIES REACTOR OR TRANSFORMER DATA

The form to submit Series Reactor or Transformer data is illustrated in Appendix D. This lists sufficient information to enable the ETAM Thermal Ratings Engineers to identify the reactor or transformer type installed from the tables in TGN(T)29 Transformer Loading Guide.

It is important that this information is submitted both when a new Series Reactor or Transformer is installed and a National Spare replaces failed equipment.

5 CABLE DATA

The form to submit Cable data is illustrated in Appendix E. This lists sufficient information to enable the ETAM Thermal Ratings Engineers to enter the cable rating data into CUP2. The rating sheet must be completed in line with TS 3.5.1 132 kV, 275 kV and 400 kV Oil Filled Cable & TS 3.5.2 XLPE Cable for Rated Voltages Above 33 kV ($U_m = 36$ kV).

It is important that this information is submitted both when a new cable is installed and any modifications are carried out on the cable (i.e. updating the cable cooling system).

6 QUAD BOOSTER DATA

The form to submit Quad Booster data is illustrated in Appendix F. This lists sufficient information to enable the ETAM Thermal Rating Engineers to enter the Quad Booster Rating data into CUP2. It is important that the information submitted should encompass all Tap positions and it may be necessary to submit multiple sheets. Each sheet should be labelled with the Tap positions that correspond to the particular rating and with the total number of Taps.

7 PROTECTION EQUIPMENT DATA

The form to submit protection equipment data is illustrated in Appendix C. The purpose of this form is to convey to the ETAM Thermal Ratings Engineers the type, the loading criteria and any settings limitations for protection equipment installed within any particular substation bay and its date of commissioning onto the Electricity Transmission System

7.1 Loading

In usual circumstances Relay settings should be set to accommodate the loading given in Policy Statement (Transmission) PS(T)010 Application & Protection Setting Policy for the National Grid UK Electricity Transmission System. In some instances setting constraints may impose a lower limit to the load. The relay setting increments will be such that in many instances the relay setting will exceed the loadings given in PS(T)010. It should be noted that it has been agreed with Market Operation that the stated rating will be based upon the relay setting and not the maximum circuit loading. It will therefore be equivalent to the relay setting minus a factor of safety.

7.2 Protection Bay Solutions

Where a bay solution is being installed the relevant standard rating, for either 400kV or 275kV feeders or SGT's should be indicated on the Thermal Protection Rating Data form.

If any restriction arises from a setting within the Bay Solution (for example due to the setting of the feeder overcurrent function) the Bay Solution entry within the table should be completed and the load restriction entered in the final column on the table.

7.3 Protection Multi – Box Solutions (i.e. Using Conventional Discrete Relays)

Where the protection is either existing, in the case of settings being changed on specific equipment or consists of a number of discrete relays the rating limitations must be completed for each individual relay, which carries secondary current.

In the case of a protection relay already installed on the Electricity Transmission System the Thermal Rating Schedule will already exist for this piece of equipment and should be revised for any new setting applied to the relay or relays fitted on that particular circuit.

8 FORMS AND RECORDS

UKBP/TP 175.01	Plant Thermal Rating Data Sheet
UKBP/TP 175.02	Protection Thermal Rating Data Sheet
UKBP/TP 175.03	Series Reactor Transformer Thermal Rating Data Sheet
UKBP/TP 175.04	Cable Thermal Rating Data Sheet
UKBP/TP 175.05	Quad Booter Thermal Rating Data Sheet

PART 2 – DEFINITIONS AND DOCUMENT HISTORY

9 DEFINITIONS

Not applicable.

10 AMENDMENTS RECORD

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	July 2010	First issue	Alasdair Chamberlain	Dave Mercer Major Projects Manager
2	January 2012	Updated to reflect revised circuit loadings in PS(T)010, Issue 2.	Alasdair Chamberlain	Ian Cartwright Business Integrity Manager
3	July 2013	Document updated due to organisational change.	Alasdair Chamberlain Capital Delivery	Stephen Johnson Capital Delivery
4	May 2014	Document updated due to organisational change.	Alasdair Chamberlain Capital Delivery Technical Assurance	Stephen Johnson Head of Business Planning, Integrity & Change
5	November 2015	Guidance on SGT ratings updated to align with PS(T)010.	Alasdair Chamberlain Capital Delivery Technical Assurance	Shaun Hughes Technical Assurance Manager

11 IMPLEMENTATION

11.1 Audience Awareness

Audience	Purpose Compliance (C) / Awareness (A)	Notification Method Memo / letter / fax / email / team brief / other (specify)
Design Assurance & Contractor Design Approval Engineers	C	Engineering Bulletin
Market Operation & Asset Management	A	Engineering Bulletin

11.2 Training Requirements

Training Needs N/A / Informal / Workshop / Formal Course	Training Target Date	Implementation Manager
N/A	N/A	N/A

11.3 Compliance

A random sample of the previous years schedules submitted to Asset Management will be audited to confirm the correct timescales are being adhered to and the content is in line with this document.

11.4 Procedure Review Date

3 years from publication date.

PART 3 - GUIDANCE NOTES AND APPENDICES

12 REFERENCES

UKBP/TP106:	Equipment Commissioning and Decommissioning
AMPM 7301:	Provision of Thermal Rating Sheets
PS(T) 010:	Application and Protection Setting Policy for the National Grid UK Transmission System
TGN(E) 26:	Current Ratings for Overhead Lines
TGN(E) 66:	Thermal Rating Capabilities of Protection Equipment
TGN(T) 29:	Transformer Loading Guide

13 BACKGROUND INFORMATION FOR PROTECTION EQUIPMENT

13.1 Supergrid Transformer (SGT) Overcurrent Protection

The thermal rating of Supergrid Transformers is 90% of the lower of the HV or LV overcurrent relay setting. Specifically it is as follows:

13.1.1 Supergrid/132kV & lower SGTs

The limiting relay for all these SGTs will be the 2 Stage HV 3 ϕ Overcurrent relay, the setting of which is determined by the transformer on-load tap changer rating. TGN(T) 029 section 6 quotes an overcurrent limit of 130% for SGTs with serial numbers below T5800 and 150% for those above T5800. The setting allows for a 10% safety factor giving values of 145% & 165% of rating respectively.

All SGTs with an on-load tap changer where the acceptable overload limit for on-load tap-changing operations is 130% have an HV overcurrent setting of 145% of the nominal rating of the SGT. These are generally the SGTs with serial numbers below T5800. The declared thermal rating for these SGTs is therefore 130% of rating.

All SGTs equipped with on-load changers where the overload limit for tap changing operations is declared as 150% have an HV overcurrent setting of 165% of the nominal rating of the SGT. These are generally are SGTs with serial numbers T5800 and above. New SGTs are in this category. The declared thermal rating for these SGTs is therefore 150% of rating.

The effect of exceeding these ratings will be to cause the relay to trip.

13.1.2 Interbus 400/275kV SGTs

The thermal rating of 400/275kV SGTs should be 90% of the lower of either the HV or LV overcurrent relays. This is usually 180% of nominal rating as the HV 2 stage OC & LV Extremely Inverse relays are normally set at 200% of rating on this equipment.

If the Overcurrent relays are not set at the recommended values then the standard rating cannot be used and 90% of the actual setting should be quoted.

The effect of exceeding these ratings will be to cause the relay to trip.

13.2 Supergrid Feeder Overcurrent Protection

The load restriction arising from a Supergrid Feeder Overcurrent Protection will be a maximum of 7600A at 400kV & 5200A at 275kV. This is derived from a setting of 115% of the maximum standard ratings. As the setting must also be less than 77% of the minimum phase to phase fault current on the circuit it may be less than the standard ratings of 7600A (400kV) & 5200A (275kV). In these cases the rating shall be 90% of the relay setting.

Therefore, the thermal limitation shall be the lesser of 7600A (400kV) or 5200A (275kV) and 90% of the relay setting.

The effect of exceeding these ratings will be to cause the relay to trip.

13.3 Supergrid Feeder Earth Fault Protection

From PS (T) 010 feeder Backup Earth Fault Relays are set to a minimum of 880A at 400kV and 600A at 275kV. This is on the basis that it has been determined that the Zero Phase Sequence current will be no more than 3.33% of the actual load current

Earth Fault Current Setting = Load Current x (3 x 3.33% [ZPS Current])

This gives values of 760A at 400kV and 520A at 275kV. Rounding these values up to include a small factor of safety gives settings of 880A & 600A respectively.

The maximum loadings of 7600A & 5200A will therefore not cause operation of the earth fault relay and so are stated on the Thermal Protection Rating Data sheet.

The effect of exceeding these ratings will be to cause the relay to trip.

13.4 Distance Protection

13.4.1 400kV Feeders

For modern numerical relays the maximum circuit loading is 7600A at 30° load angle with a 20% load encroachment safety margin. Thus the Zone 3 load encroachment values set on distance relays is $(7600 / 0.8) = 9500A$. Thus the stated standard loading of 7600A applies.

For older relays (such as THR & SHNB) a 30% load encroachment margin should be used.

In both cases the effect of exceeding this rating will be to cause the relay to trip.

13.4.2 275kV Feeders

For modern numerical relays the maximum circuit loading is 5200A at 30° load angle with a 20% load encroachment safety margin. Thus the Zone 3 load encroachment values set on distance relays is $(5200 / 0.8) = 6500A$. Thus the stated standard loading of 5200A applies.

For older relays (such as THR & SHNB) a 30% load encroachment margin should be used.

In both cases the effect of exceeding this rating will be to cause the relay to trip.

13.5 Pilot Wire Protection

The stated post fault continuous rating shall be 5% less than the pilot wire protection starting relay drop-off current. The effect of continuously exceeding the rating is to place the protection at risk of maloperation.

13.5.1 Explanation

- a) If a through fault picks the starters up, they will not reset again until the load current falls below the starter reset current.
- b) Failure of the load current to fall below the starter reset current would leave the starters picked up. Some relays have no indication of the starters being picked up. If whilst the starters are picked up the pilots become faulty, there is a significant risk of the relay tripping.

13.5.2 Notes

- a) Pilot wire protection does not impose a limit with respect to short term ratings, since it is considered an acceptable risk to operate with the starters picked up for short term rating times.
- b) The circuit fault current under minimum plant conditions must exceed the starter pick-up current setting to ensure the relay will trip on an internal fault. In exceptional cases these criterion may not be met, thus requiring the starter pick-up current setting to be reduced which in turn would reduce the post fault continuous rating.

13.6 Phase Comparison Protection

This refers to carrier and voice frequency protection. Generally speaking the effect of exceeding the rating is to cause the protection to fail to trip. In terms of circuit rating a number of criterions need to be satisfied as follows:

13.6.1 Impulse Starter Pick-up

To ensure the relay will trip for a circuit internal fault the Positive Phase Sequence (PPS) High Set Impulse Starter must pick-up. This requires the 3 phase fault current under minimum plant conditions to exceed the maximum load current. Where necessary the circuit rating must be reduced to satisfy this criterion, or a clear statement obtained from Market Operations to confirm load to fault in-feed conditions. Equally when considering the Negative Phase Sequence (NPS) High Set Impulse Starter, the NPS component of fault (under minimum plant conditions) must exceed the NPS component of load current.

13.6.2 Modulator Pick-up

To ensure the relay will trip for a circuit internal fault the modulator must pick-up. This requires the earth fault current under minimum plant conditions to exceed the load current by a certain factor. Where necessary the circuit rating must be reduced to satisfy this criterion, or a clear statement obtained from Market Operations to confirm load to fault in-feed conditions

13.6.3 NPS Low Set Continuous Starter Pick-Up

- a) Load current tends to be slightly unbalanced and as such carries a component of NPS current, which is usually expressed as a % of the PPS load current.
- b) If a through fault picks the NPS low set starters up, they will not reset until the NPS component of load current falls below the starter reset current.
- c) This situation is further complicated by the fact that the NPS starter network within the relay is not perfect and it also accepts a small proportion of PPS current, which makes the NPS reset current value even lower.
- d) The effect of low set starter continuous pick is as follows:
 - (i) On newer equipment a 'continuous transmission' monitor renders the relay inoperative after 10 seconds.
 - (ii) On older equipment the amplifier is short time rated and thus could be damaged.
 - (iii) Continuous transmission is against Home Office regulation.
- e) On some types of relay the impulse starter setting and the NPS continuous starter setting have fixed relationship to each other. The effect of making the NPS continuous starter setting higher is to create difficulties in setting the impulse starter as described in Appendix A. Thus to obtain satisfactory settings the circuit rating may have to be reduced.
- f) The NPS component of load current shall be taken as 10% or as otherwise agree with System Operations.
- g) A summary of the Low Set NPS continuous starter setting is shown below:

Amps _____ LS NPS Cont. Starter pick up setting.