

Consideration of Comments on Relay Loadability Reference Document

The Standards Committee thanks all commenters who submitted comments on the Relay Loadability Reference Document. This document was posted for a 30-day public comment period from March 20, 2008 through May 3, 2008. The stakeholders were asked to provide feedback on the reference document through a special Comment Form. There 9 sets of comments, including comments from 15 different people from 9 companies representing 4 of the 10 Industry Segments as shown in the table on the following pages.

All comments received on the reference document can be viewed at:

<http://www.nerc.com/~filez/standards/Relay-Loadability.html>

If you feel that your comment has been overlooked, please let us know immediately. Our goal is to give every comment serious consideration in this process! If you feel there has been an error or omission, you can contact the Vice President and Director of Standards, Gerry Adamski, at 609-452-8060 or at gerry.adamski@nerc.net. In addition, there is a NERC Reliability Standards Appeals Process.¹

¹ The appeals process is in the Reliability Standards Development Procedures:
<http://www.nerc.com/standards/newstandardsprocess.html>.

Index to Questions, Comments, and Responses

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The Industry Segments are:

- 1 — Transmission Owners
- 2 — RTOs, ISOs
- 3 — Load-serving Entities
- 4 — Transmission-dependent Utilities
- 5 — Electric Generators
- 6 — Electricity Brokers, Aggregators, and Marketers
- 7 — Large Electricity End Users
- 8 — Small Electricity End Users
- 9 — Federal, State, Provincial Regulatory or other Government Entities
- 10 — Regional Reliability Organizations, Regional Entities

Commenter		Organization	Industry Segment									
			1	2	3	4	5	6	7	8	9	10
1.	Dean Bender	Bonneville Power Administration	x		x		x	x				
2.	James Y. Busbin (G1)	Southern Company Services, Inc.	x									
3.	J.T. Wood (G1)	Southern Company Services, Inc.	x									
4.	Marc Butts (G1)	Southern Company Services, Inc.	x									
5.	Roman Carter (G1)	Southern Company Services, Inc.	x									
6.	Terry Coggins (G1)	Southern Company Services, Inc.	x									
7.	Chris Wilson (G1)	Southern Company Services, Inc.	x									
8.	Greg Ward/Rafeal Garcia	Oncor Electric Delivery Company LLC	x									
9.	Greg Rowland	Duke Energy Corporation	x		x		x	x				
10.	Thad K. Ness	American Electric Power	x		x		x	x				
11.	Rick White	Northeast Utilities	x									
12.	Kris Manchur	Manitoba Hydro	x		x		x	x				
13.	Alissia Dawes	Hydro One Networks, Inc.	x		x							
14.	Michael J. Ranalli (G2)	National Grid	x		x							
15.	Phil Tatro (G2)	National Grid	x		x							

G1 — Southern Company Services, Inc.

G2 — National Grid

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1. Does the “Determination and Application of Practical Relaying Loadability Ratings” reference document aid in either the implementation or understanding of the Transmission Relay Loadability standard?

Summary Consideration: The commenters felt that the Relay Loadability Reference Document is useful in aiding the implementation and understanding of the Transmission Relay Loadability standard.

Organization	Question 1:	Question 1 Comments:
Duke Energy Corporation	Yes	We like this reference document, and believe it is useful in implementing the standard.
Response: Thank you for your input.		
National Grid	Yes	The Reference Document contains a significant volume of information to assist the industry in applying the Relay Loadability Standard, PRC-023. The Reference Document should be posted as a permanent reference with the Standard on the NERC website.
Response: Thank you for your input.		
Bonneville Power Administration	Yes	
Southern Company Services	Yes	
Oncor Electric Delivery Company LLC	Yes	
AEP	Yes	
Northeast Utilities	Yes	
Manitoba Hydro	Yes	
Hydro One Networks	Yes	

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2. Is the terminology in the “Determination and Application of Practical Relaying Loadability Ratings” reference document consistent with the related standard? If not please explain.

Summary Consideration: Some inconsistencies are noted by a commenter and minor editorial changes were made to the Relay Loadability Reference Document in response.

Organization	Question 2:	Question 2 Comments:
Southern Company Services	No	Please see response to Question 4.
Response: The SDT greatly appreciated the thoughtful recommendations in the comment and commends the thoroughness of the review. The team has considered the suggested mark ups and made changes to the Relay Loadability Reference Document.		
Northeast Utilities	Yes	Linking the sections of the reference document to the requirements in the standard is a significant aid in understanding both documents.
Response: Thank you for your input.		
Bonneville Power Administration	Yes	
Oncor Electric Delivery Company LLC	Yes	
Duke Energy Corporation	Yes	
AEP	Yes	
Manitoba Hydro	Yes	
Hydro One Networks	Yes	
National Grid	Yes	

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3. Has the development of the “Determination and Application of Practical Relaying Loadability Ratings” reference document been approved through some other open process? Please identify.

Summary Consideration: None of the commenters indicated that the Relay Loadability Reference Document was approved through some other process. However the technical content was developed by the NERC SPCTF and approved by the NERC Planning Committee prior to the beginning of the standard development process for this project.

This Relay Loadability Reference Document conforms to a newly developed process by the Standards Committee.

Organization	Question 3:	Question 3 Comments:
Bonneville Power Administration	No	
Southern Company Services		Not to our knowledge.
Oncor Electric Delivery Company LLC	No	
Duke Energy Corporation	No	We are not aware of approval through another process.
AEP	No	We do not know of any other open approval process.
Northeast Utilities	No	While the reference document has accompanied the standard through several revision reviews, we're not aware of any official posting of the reference document for review.
Manitoba Hydro	No	
Hydro One Networks	No	none known
National Grid	No	

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4. Please provide any other comments you have on the “Determination and Application of Practical Relaying Loadability Ratings” reference document that you haven’t already provided.

Summary Consideration: A commenter identified a number of editorial changes to the Relay Loadability Reference Document and the SDT agreed to review and modify the document as suggested. Another commenter asked about possible conflicts with Facility Ratings. The SDT explains that requirement R1.12 in the standard specifies that the relay loadability setting shall be made the Facility Rating of the line or equipment. Therefore a conflict cannot exist.

Organization	Question 4 Comments:
Southern Company Services	We feel we have found several inconsistencies between the reference document and PRC-023. We are reviewing these internally and will submit them to the SCPTF under separate cover.
Response: The SDT greatly appreciated the thoughtful recommendations in the comment and commends the thoroughness of the review. The team has reviewed the suggested mark ups and made the necessary changes to the Technical Reference Document. The comments are attached to this document, along with the responses.	
AEP	The reference document has not addressed guidance on situations where the application of loadability requirements conflict with the primary directive that protective relays are to be set to reliably detect all fault conditions and protect the electrical network from these faults.
Response: PRC-023-1 R1.12 establishes requirements to address this situation. The SDT does not believe that additional technical reference is necessary on this subject, since in this case the resulting relay loadability becomes the Facility Rating.	
Bonneville Power Administration	OK as written
Oncor Electric Delivery Company LLC	No additional comments
Northeast Utilities	None.

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The following comments were submitted by Southern Company Services and were embedded in a pdf version of the reference document.

Comment: P. 1 – R1.1

$Z_{relay30}$ = Relay reach in primary Ohms at a 30 degree power factor angle

For consistency, replace the text with "...at a power factor angle of 30 degrees." Note the last sentence in the paragraph from section R1.

Response: Agreed. The drafting team has adopted this suggestion.

Comment: P. 1 – R1.1 – shaded box

Is the word, 'tripping' needed?

Response: No – it has been removed.

Comment: P. 1 – R1.1 – shaded box

This terminology lacks consistency with the sentence above. Here, "1.5 times" is used instead of "150%".

Response: The text has been changed to say "150% of"

Comment: P. 1 – R1.1 – shaded box

The example is not consistent with the paragraph above where the highest "seasonal" Facility Rating is described.

Response: This was changed and the word "seasonal" was inserted.

Comment: P. 1 – R1.1 – shaded box

Is the example redundant? It repeats the formula that is illustrated earlier in the section.

Response: Thank you for your question. The formula is repeated in the shaded box sections throughout this technical reference as a "key concepts" aid. The content of the shaded box is intended to provide a reader with a quick reference of the main idea of the section and serves as a memory jog device.

Comment: P. 1 – R1.2 – First sentence

Two concerns:

(1) Proposed changes to the language: "When the study to establish the original loadability parameters was performed, it was based on the 4-hour facility rating. The intent of the 150% factor applied to the Facility Rating in the loadability requirement was to approximate the 15-minute rating of the transmission line and add some additional margin."

(2) Question: Should the facility rating be capitalized? The proposed text replaces "facility ampere rating" with Facility Rating.

Response: Accepted.

Comment: P. 1 – R1.2 – Last sentence

Replace "15-minute rating" with the 15-minute highest seasonal Facility Rating. This would be consistent with the terminology mentioned earlier in the document.

Response: Accepted.

Comment: P. 2 – shaded box

Replace 1.15 with 115% for consistency

Response: Accepted.

Comment: P. 2 – shaded box

Why is "winter" used in this example? Should the example reference the "highest seasonal Facility Rating?"

Response: Replaced with "highest seasonal Facility Rating."

Comment: P. 2 – shaded box

Facility Rating, not ampere rating

Response: Replaced with "highest seasonal Facility Rating."

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Comment: P. 2 – shaded box - Throughout the document, the use of "relay" in the examples is not consistent. Reference the last sentence in the paragraph from R1 where it states "The relay performance shall be evaluated at 0.85 per unit voltage..." Would it be appropriate to strike the word relay from the examples?

Response: Thank you for this comment. The SDT prefers the text as written as it is equivalent in both contexts.

Comment: P. 2 – R1.3 – First Sentence

For consistency, insert "maximum theoretical power transfer capability" (instead of "maximum power transfer capability") as indicated in Standard PRC-023-1.

Response: Accepted.

Comment: P. 2 – equation explaining V_S and V_R

"Line-to-Line voltage" is used in the prior section. Should this be consistent throughout the document?

Response: Accepted

Comment: P. 2 – bottom of page – last sentence

The real maximum power - "real" should be "actual"

Response: Accepted

Comment: P3 – equation for Maximum Power

V = Nominal "phase-to-phase" bus voltage – "phase-to-phase" should be "line-to-line"

Response: Accepted

Comment: P3 – shaded box

Replace 1.15 times with 115% of

Response: Accepted

Comment: P3 – shaded box

Is the voltage in the formula below correct? The voltage described here is V_{L-L} (Line-to-Line) and was previously defined as "Rated line-to-line voltage".

Response: The voltage is expressed at the relay location. The definition is correct.

Comment: P.3 – shaded box

Is the example redundant? It repeats the formula that is illustrated earlier in the section.

Response: Thank you for your question. The formula is repeated in the shaded box sections throughout this technical reference as a "key concepts" aid. The content of the shaded box is intended to provide a reader with a quick reference of the main idea of the section and serves as a memory jog device.

Comment: P4. – explanation of Figure 2 – word "source" in 3rd bullet

The definition uses generation subtransient impedances but fault parameters denote only Thevenin source impedances. Is this consistent?

Response: Yes this is consistent because a fault program will naturally produce Thevenin source impedances as discussed here.

Comment: P4. – explanation of Figure 2 – P_{max} formula

The P_{max} formula includes variables for sending and receiving. Is there a generator at the receiving end?; Is this formula correct?

Response: Yes, this is correct. The formula expresses a generic 2-bus load flow situation where sources are located behind each terminal.

Comment: P3. – explanation of Figure 2 – the following definitions in the P_{max} formula:

ES = Thévenin phase-to-phase voltage at the system sending bus

ER = Thévenin phase-to-phase voltage at the system receiving bus

δ = Voltage angle between ES and ER

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These variables are not used in the formula.

Response: Replaced the following definitions:

E_s = the line-to-line internal voltage for the generator modeled behind the equivalent sending end reactance X_s

E_r = the line-to-line internal voltage for the generator modeled behind the equivalent receiving end reactance X_r

Retain "delta" = Voltage angle because it is correct as written.

Comment:P3. – explanation of Figure 2 – the following definition in the Pmax formula:

V = Nominal phase-to-phase system voltage

Is there any other nomenclature to describe the Thevenin equivalent parameters for X_s & X_r ?

Response: Replaced with Line-to-line bus voltage

Comment: P. 5 – 2nd shaded box - Example

The explanation for R1.3.2 provides a different definition for voltage. It describes V as the nominal phase-to-phase system voltage (not bus voltage as described in R1.3.1).

Is VL-L, as described in the example, the correct voltage? The I_{total} formula above uses the V -nominal voltage.

Response: The explanation is for R.1.3.1, an infinite bus is assumed i.e., "no source impedance" and therefore the system voltage and bus voltage are identical. For this requirement bus voltage explicitly must be used as noted in the detailed explanation.

Comment: P5. R1.4 - Propose deleting the following sentence:

Capacitor cans have a short-term over voltage capability that is defined in IEEE standard 1036. This allows series capacitors to carry currents in excess of their nominal rating for a short term.

Proposing adding the following sentence in its place:

"Capacitors have a short-term, over-voltage capability which allows them to carry currents in excess of their nominal rating (reference IEEE standard 1036)."

Response: It is deleted.

Comment: P5. R1.4 – last sentence – reference to 30-minute series capacitor emergency ratings

Is there more than one 30 minute emergency rating? Is the rating for series capacitors or a capacitor bank?

Response: There may be multiple ratings specific in which case the 30 minute rating or nearest to it would be the rating of interest. This is specifically for series cap ratings.

Comment: P.6 – Paragraph under Figure 3

1st sentence - Figure 3 illustrates a "Triggered Gap", not a "spark gap".

Response: Changed to "triggered"

Comment: P.6 – Paragraph under Figure 3

1st sentence – reference to "bypassed" - There is no definition for Isolating MOD (Motor Operator Disconnect)

Response: Added after breakers...or Motor Operated Disconnects (MODs). Isolating MODs are not pertinent to this discussion but are shown because they would be present anyway.

Comment: P.6 – Paragraph under Figure 3

2nd sentence – Replace, "Protective gaps and MOVs" with "Protective gaps and/or MOVs"

Response: This sentence discusses the behavior of protective gaps and MOVs whichever may be present in a given installation.

Comment: P.6 – Paragraph under Figure 3

2nd sentence - Is "Protective gaps" the same as Triggered Gap?

Response: Replaced with "triggered"

Comment: P6. – Definition of $V_{protective}$

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There could be a difference in the voltage across a "triggered gap" (spark gap) or the MOV. Figure 3 does not include $V_{\text{protective}}$ in the illustration.

Response: The SDT drafting believes this is clear and does not need further explanation.

Comment: P6. – 2nd to last paragraph on page

Change, "The capacitor protection limits" to The "series capacitor protection limits..."

Response: The document has been revised in consideration of your comment.

Comment: P6. – 2nd to last paragraph on page

Is this consistent with the explanation in R1.3 where it states that "At maximum power transfer, the real component of current and the reactive component of current are equal"?

Response: There is no inconsistency.

Comment: P6. – 1st sentence of last paragraph – reference to "highest series capacitor emergency current Rating"

Is there more than one emergency current rating for series capacitors? If there is more than one, then the sentence should be revised to include an "either/or" statement for the two scenarios. Additionally, the last sentence may be deleted as it appears to be redundant based on the prior sentence.

Response: This guidance addresses either the highest series capacitor's emergency rating or the maximum power transfer per R1.3.

Comment: P7. – Figure 4

Does the illustration and terminology describe what a "Weak Source System" is?

Response: The SDT asserts that it does.

Comment: P7. – Definition of V_{S-R}

Does the V_S & V_R describe a sending and receiving voltage? If yes, then the nomenclature does not appear to be consistent with the explanation.

Response: The V_{S-R} is actually describing the magnitude of a complex voltage between V_S and V_R .

Comment: P7. – In the following sentence, where does 115% come from? Is this form industry practice? Also, does the margin intend to address device errors or device variability? Errors implies that something is wrong.?

It is necessary to increase the line end fault current I_{fault} by 2 to reflect the maximum current that the terminal could see for maximum power transfer and by 115% to provide margin for device errors.

Response: Thank you for your questions. The factor is derived from operating experience and is therefore empirical. "Errors" is intended to describe inaccuracies due to "drifting" that may be present in older style electro-mechanical devices.

Comment: P7. – Definition of I_{max}

Where does "1.05" come from?

Response: It is a per unit factor.

Comment: P8. – Reference Figure 5. The illustration does not highlight "Load Center" similar to other illustrations in the document. Similarly, other illustrations (Figures 6 & 7) refer to a Generation Center, not a Generation Bus.

Response: The term Load Bus replaces Load Center for consistency. Thank you.

Comment: P8. – Should "nominal" be more appropriate?

Response: The term "nameplate" is the preferred choice.

Comment: P8. – Prior language referred to "per-unit". Is that what is meant here?

Response: The document is revised to 1.0 per unit voltage. Thank you.

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Comment: P8. – Requirement No. 1.6 in PRC-023-1 cites 230%. Is this consistent?

Response: The 230% is a result of the product of 1.15 and the 200% rating.

Comment: P9. – Consider adding a sentence explaining I_{max} . For example: " I_{max} can be determined by the equation:...."

Response: The SDT accepts the addition of text.

Comment: P9. – Insert this paragraph above the illustration in Figure 6.

Response: The SDT accepts the addition of text.

Comment: P9. – Requirement 1.6 of PERC-023-1 includes a limit of 230% of the aggregated generation nameplate capability. It is not clear where the formula attempts to satisfy that limit.

Response: Thank you for your question. Refer to MVA_{max} and I_{max} definitions.

Comment: P10. – Generation Center

Response: The addition of Center is accepted.

Comment: P10. – Requirement 1.7 says "configuration".

Response: The text is changed per your comment.

Comment: P10. – Set the tripping relay at the load center....

Response: The text is changed per your comment.

Comment: P11. – The word "cohesive" is not used in the Standard's requirement.

Response: Removed.

Comment: P11. - With regards to "single line", does this imply that one line can carry the total line? What if there were 4, 5, or more lines? Should this be "circuit"?

Response: The requirement intends that the extreme contingency be used, reflecting all but one of several parallel lines are removed. No, lines is correct.

Comment: P11. – Is this consistent with the example below where I_{max} is mentioned?

Response: The text is changed to I_{max}

Comment: P12. – The word "cohesive" is not used in the Standard's requirement.

Response: Removed.

Comment: P12. – "However, under normal conditions, only minimal current can flow from the load center to the transmission system. The forward reaching relay..."

Response: The text is changed per your comment.

Comment: P12. – transmission system

Response: The text is changed per your comment.

Comment: P12. –configuration.

Response: Configuration, thank you.

Comment: P12. – protection

Response: The use of the adjective "protective" is necessary in the context of other adjectives and nouns used in this sentence.

Comment: P12. – operate the breaker...

Response: Not accepted because we are discussing the operation of the relays themselves and not the resultant action.

Comment: P13. – breaker tripping...

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Response: Not accepted. This scenario pertains to the transformer tripping off and not the relay (with indifference to what devices isolate the transformer).

Comment: P13. – "Lines" and "circuits" are interchanged throughout the section.

Response: Changed circuits to lines in all instances, thank you.

Comment: P13. – it may not be necessary if the relays with mho characteristics are set at 125% or the line length.

Response: Accepted, thank you.

Comment: P14. – This terminology is not consistent with prior definitions where either line-to-line or phase-to-phase is used.

Response: Accepted and globally changed, thank you.

Comment: P14. – Should this be expressed in ohms (reference Z_{line})?

Response: Accepted, thank you.

Comment: P14. – The explanation refers to this as the "relay operating current".

Response: Accepted, thank you.

Comment: P14. – mho characteristic to a relay...

Response: Replaced mho with mho-characteristic, thank you.