

# APPENDIX D

## Engineering Studies

For the engineering studies there are two main parts of the study: 1. Does the distributed generator cause a problem? and 2. What would it cost to make a change to handle the problem.? The first question is relatively straightforward to determine as the Dakota Electric Engineer reviews the proposed installation. The second question typically has multiple alternatives and can turn into an iterative process. This iterative process can become quite large for more complex generation installations. For the Engineer there is no “cook book” solution which can be applied.

For some of the large generation installations and/or the more complex interconnections the Dakota Electric Operator may suggest dividing up the engineering studies into the two parts; identify the scope of the problems and attempt to identify solutions to resolve the problems. By splitting the engineering studies into two steps, it will allow for the Applicant to see the problems identified and to provide the Applicant the ability to remove the request for interconnection if the problems are too large and expensive to resolve. This would then save the additional costs to the Applicant for the more expensive engineering studies; to identify ways to resolve the problem(s).

This appendix provides an overview of some of the main issues that are looked at during the engineering study process. Every interconnection has its unique issues, such as relative strength of the distribution system, ratio of the generation size to the existing area loads, etc. Thus many of the generation interconnections will require further review of one or several of the issues listed.

- Short circuit analysis – the system is studied to make sure that the addition of the generation will not over stress any of the Dakota Electric equipment and that equipment will still be able to clear during a fault. It is expected that the Applicant will complete their own short circuit analysis on their equipment to ensure that the addition of the generation system does not overstress the Applicant’s electrical equipment.
- Power Flow and Voltage Drop
  - Reviews potential islanding of the generation
  - Will Dakota Electric Equipment be overloaded
    - Under normal operation?
    - Under contingent operation? With backfeeds?
- Flicker Analysis –
  - Will the operation of the generation cause voltage swings?
    - When it loads up? When it off loads?
  - How will the generation interact with Dakota Electric voltage regulation?
  - Will Dakota Electric capacitor switching affect the generation while on-line?
- Protection Coordination
  - Reclosing issues – this is where the reclosing for the distribution system and transmission system are looked at to see if the Generation System protection can be set up to ensure that it will clear from the distribution system before the feeder is reenergized.
    - Is voltage supervision of reclosing needed?
  - Is transfer-trip required?
  - Do we need to modify the existing protection systems? Existing settings?
  - At which points do we need “out of sync” protection?
  - Is the proposed interconnection protection system sufficient to sense a problem on the Dakota Electric distribution system?
  - Are there protection problems created by the step-up transformer?

- Grounding Reviews
  - Does the proposed grounding system for the Generation System meet the requirements of the NESC? “National Electrical Safety Code” published by the Institute of Electrical and Electronics Engineers (IEEE)
  
- System Operation Impact.
  - Are special operating procedures needed with the addition of the generation?
  - Reclosing and out of sync operation of facilities.
  - What limitations need to be placed on the operation of the generation?
  - Operational Var requirements?.