SAARC ENERGY CENTRE
Energy for Peace & Prosperity

Online training of SAARC Professionals on Small, Mini and Micro Hydro Power Generation (Sept 13 - 17, 2021)

Understanding SMMHP plants operations using software

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Lecture Content

- **Why use software for SMMHP Operations?**
- **Commercial and Open-Source Software**
- **Analyses that can be Performed**
- **Key Steps in Software-based Analysis**
- **Demonstration Model Details**
- **Software Demonstration**
- **Concluding Remarks**

Why use Software for SMMHP Operations?

- We can understand the impact of various grid conditions before they occur
- We can prepare a plan to resolve any adverse impact on the plant
- We can improve reliability and quality of power delivery because we are not caught unawares
- We can fail in software, but not in the field!

Some Software for SMMHP Operations

- Several commercial and open-source software are available
- Software selection depends on the timescale(s) of interest
- For reliability purposes, one good commercial software can typically serve all needs

Software Name	License Type	Primary Application
GE-PSLF	Commercial	Industry
PSSE	Commercial	Industry
DIgSILENT	Commercial	Industry and Research
PSCAD	Commercial	Industry and Research
MAFRIT	Open-Source	Research

Almost all commercial software have provisions to provide academic or limited system size licenses

Studies in Software

- Studies can be performed at various timescales
  - **Steady State or Power Flow Studies** (e.g., to understand line thermal loadings; minutes-level voltage changes)
  - **Short-Circuit Studies** (for relay setting and coordination)
  - **Dynamics Studies** (for understanding system stability or impact of solar transients on frequency)
- We can spend an entire day on each software/study…I have 30 minutes today!

Our 30-minute goals

- Using GE-PSLF demonstrate the following:

  - Steps to build a model
  - Solving steady-state power flow
  - Fault, generator trip, and solar transient conditions and their impact on generator's performance

Steps to Build a Model

- **Most important** - Get data (network data, short-circuit data, dynamics data).
  - Synthetic datasets may provide a start. E.g., IEEE datasets and TAMU datasets (https://electricgrids.engr.tamu.edu/)
  - Your own system's data is indispensable though.
- Build network model
- Build dynamics and short-circuit data files
- Get a stable operating point
- Create disturbances and observe response of SMMHP plants

Model used Today

- **Modified IEEE 9-bus** (~300 MW total system load)
  - 9 Buses, 6 lines, and 3 transformers
  - 3 generators (one with governor)
  - 3 loads
- **Dynamic Models**
  - GENROU for synchronous generators
  - GGOV1 for governor (w/ droop and isochronous operation modes)
  - EXAC1 exciters (AC excitation system)
  - Solar (modelled as negative load…more complex dynamic models are available)

Let us get started with the demonstration now!

Concluding Remarks

- Software-based operations analysis enables better operations of SMMHP plants
- Several software are available…choice depends on the operations timescale(s) of interest
- We are better prepared to handle unexpected events
- **Data is critical –** synthetic data can fill gaps or help us get started but it cannot replace actual system and plant data

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Thank you