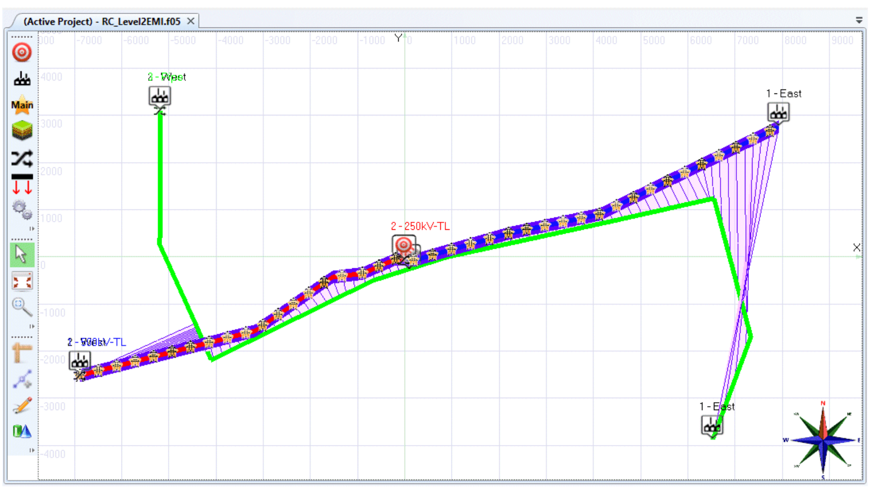
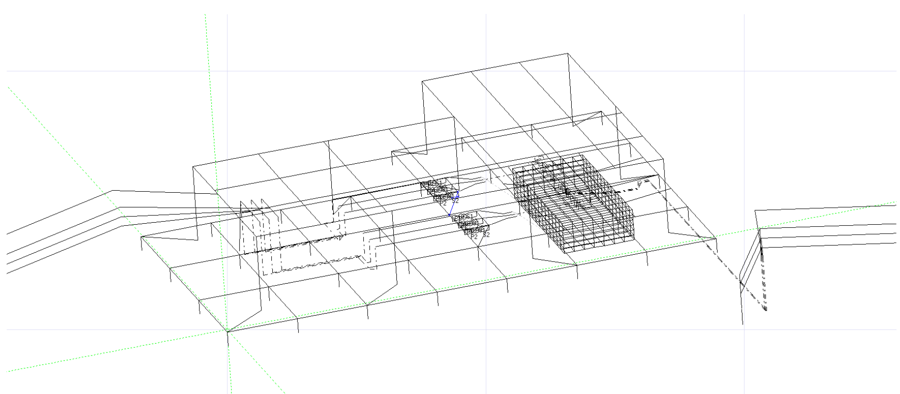
Level 2 Certification

Combined AC Interference & Grounding





Course Schedule

Day 1	
8:30 am – 12:00 pm	**1:00 pm – 5:30 pm**
• Introduction of instructors and support personnel • Project description • Overview of training goals • Map data review • Soil resistivity Measurement Interpretation: RESAP	• Begin creation of RowCAD model • Entity models for valve and substation in RowCAD, grounding impedance • Circuit definitions in RowCAD • Creation of steady state Right-of-Way model

Day 2	
8:30 am – 12:00 pm	**1:00 pm – 5:30 pm**

• Creation of HIFREQ steady state model
  ○ Path coordinates import
  ○ Conductor definitions
  ○ Transformer definitions
  ○ Creation of transmission line
	• Completion of HIFREQ steady state model
	• Comparison of steady state results between HIFREQ, Right-of-Way

Day 3	
8:30 am – 12:00 pm	**1:00 pm – 5:30 pm**
• Fault Conditions in Right-of-Way • Fault Conditions in HIFREQ • Comparison of fault results between HIFREQ, Right-of-Way	• Safety Considerations: pipe, valve, substations, decoupler ratings, etc. • Design criteria • Designing mitigation in Right-of-Way

Day 4	
8:30 am – 12:00 pm	**1:00 pm – 5:30 pm**
• Complete fault conditions modeling with mitigation • Confirmation of meeting all design criteria	• Advanced Grounding topics and modeling: GIS, transformers; EM Fields, seasonal variations etc.

Day 5
8:30 am – 12:00 pm
• Summary AC interference • SESTLC demo • Corrosion (CorrCAD) • Decoupler ratings • Arcing • Auto-Transient • Questions & answers

Level 2 Certification: Advanced - Substation Grounding and EMI Specialization Combined

The Level 2 training is designed for Level 1 graduates who wish to learn to perform studies themselves and carry out design work in one of two areas of specialization: substation grounding (including lightning shielding) and power line electromagnetic interference. Level 2 graduates are recognized by SES as having the ability to carry out such studies using the CDEGS software package, without supervision, and evaluate the work of others.

Prerequisites:

- Practical Experience: At least two years of work experience in electrical engineering; alternatively, a degree in electrical engineering or physics and one year or more of work experience in electrical engineering.
- Level I Certification

Period of Validity:

Six years. After this period, the certified candidate must attend an updated course and pass the associated exam.

Course Description:

There are three Advanced Certification (Level 2) specializations:

- Grounding Performance of High Voltage Substations.
- Interference from High Voltage Lines (EMI).
- Grounding Performance of High Voltage Substations and Interference from High Voltage Lines (EMI) combined.

Regardless of the specialization chosen for Certification Level 2, the next certification level (i.e., Level 3: Expert) focuses on topics that are not covered in Level 2 specialization chosen by the candidate. The Expert Level certification therefore attests to expertise in both subject areas. Candidates must complete and pass an exam at the training session to verify their mastery of the material taught at the course and submit proof of the required industry experience (this can include attendance at SES Users' Group Conferences, technical reports, publications, etc.).

1. Upon completion of the Advanced Certification course specializing in Grounding Performance of High Voltage Substations, candidates will be able to:

- Specify all field measurements required for the completion of a study, including specification of appropriate equipment and test procedures.
- Interpret accurately and refine soil resistivity measurements as well as Fall of Potential, touch and step voltage measurements.
- Determine the appropriate soil structure models and their limiting cases due to seasonal and geographical variations.
- Construct realistic soil models of complex environments using finite volume models.
- Build accurate models of electric substations located in rural, semi-urban and urban areas and carry out the required fault current distribution analysis and complete the design of their grounding systems with all necessary mitigation measures.
- Model power cables including pipe-type cables, gas insulated substations (GIS) and gas insulated lines (GIL), as applicable.

- Include in the computer model various transformers types such as three-phase, three-winding, auto- and HVDC special type transformers, for accurate modeling of circulating currents during fault conditions in a substation or outside the substation.
- Evaluate electrical safety concerns and be able to identify unsafe conditions.
- Carry out comprehensive lightning shielding designs of substations and industrial plants.
- Apply appropriate insulation coordination that provides overvoltage protection for communication circuits entering a site.
- Apply various economical mitigation techniques to insure the safe performance of the grounding design.

2. Upon completion of the Advanced Certification course specializing in Interference from High Voltage Lines (EMI), candidates will be able to:

- Specify all soil resistivity measurements required along a joint-use corridor to be studied for AC interference effects, including specification of appropriate equipment and test procedures.
- Interpret accurately and refine soil resistivity measurements.
- Determine the appropriate soil structure models and their limiting cases due to seasonal and geographical variations.
- Build accurate models of transmission and distribution lines entering electric substations located in rural, semi-urban and urban areas.
- Select appropriate tower structure configurations and ground impedances along the lines.
- Model power cables including pipe-type cables and gas insulated lines (GIL), as applicable.
- Select appropriate models of gas and oil pipes, water pipes, railway tracks and communication lines, as applicable.
- Understand reasonably well the concerns of gas and oil pipeline companies, railway companies and communication line companies in order to address all important issues adequately.
- Evaluate electrical safety concerns and be able to identify unsafe conditions specific to each utility or industry.
- Understand the various mitigation techniques that are applicable to a specific utility and provide economical mitigation techniques to insure the safe performance of the affected utility.
- Carry out a comprehensive analysis of the performance of the entire joint-use corridor during steady-state and fault conditions.

1. Resistivity Measurements and Interpretation

- Specify all soil resistivity measurements required along a joint-use corridor to be studied for AC interference effects, including specification of appropriate equipment and test procedures.
- Interpret accurately and refine soil resistivity measurements.
- Determine the appropriate soil structure models and their limiting cases due to seasonal and geographical variations.

2. **Building Accurate Electric Networks and Exposed Utility Lines**
   - Specify all required information and data that must be collected from all stake holders in order to be able to build realistic and accurate computer models in rural, semi-urban and urban areas.
   - Build accurate models of transmission and distribution lines entering electric substations located in rural, semi-urban and urban areas.
   - Select appropriate tower structure configurations and ground impedances along the lines.
   - Model power cables including pipe-type cables and gas insulated lines (GIL), as applicable.
   - Select appropriate models of gas and oil pipes, water pipes, railway tracks and communication lines, as applicable.

3. **Computer Analysis and Interpretation of Results**
   - Determine the required steady-state and fault scenarios that need to be examined in order to fulfill the requirements of the study.
   - Carry out detailed computer analysis using the most appropriate software packages, i.e., MultiFields or Right-of-Way. Once the most appropriate software package has been selected, determine which software package and method to use for validation purposes.
   - Detailed review and use of SESCAD, ROWCAD, SESTLC, Right-of-Way and GRSPLITS-3D and MultiFields.
   - Carry out a comprehensive analysis of the performance of the substation during steady-state and fault conditions assuming one single type of soil structure along the entire right-of-way model based on the most stringent steady-state and fault conditions encountered during the analysis.
   - Carry out a comprehensive analysis of the performance of the entire joint-use corridor during steady-state and fault conditions assuming one single type of soil structure along the entire right-of-way model based on the most stringent steady-state and fault conditions encountered during the preceding analysis.
   - Interpretation of the computation results of all software packages.

4. **Validation by Comparison**
   - Using the alternate software package (i.e., the one the one selected above for validation purposes), carry out a comprehensive analysis of the performance of the entire joint-use corridor during steady-state and fault conditions based on the single type of soil structure model selected above and for the most stringent steady-state and fault conditions encountered during the preceding analysis as done above.
   - Confirm that, in all likelihood, the computer model as built does indeed represent a realistic rendering of the real situation.
   - Carry out a quick safety analysis of the substation and discuss mitigation measures without implementing them in the computer model.
   - Understand Stake Holders Issues
   - Understand reasonably well the concerns of gas and oil pipeline companies, railway companies and communication line companies in order to address all important issues adequately.
   - Evaluate equipment and material integrity issues and electrical safety concerns along the pipeline route and be able to identify unsafe conditions specific to each utility or industry.

5. **Mitigation Techniques**
   - Understand the various mitigation techniques that are applicable to a substation under fault conditions and provide economical mitigation techniques to insure the safe performance of the affected substation.
   - Apply safety mitigation measures to the substation and repeat the computer analysis of the performance of system during steady-state and fault conditions with the selected mitigation measures and prove that all concerns and issues the substation have been resolved using economical solutions.
   - Understand the various mitigation techniques that are applicable to a specific utility and provide economical mitigation techniques to insure the safe performance of the affected utility.
   - Apply mitigation measures along the pipeline route and repeat the computer analysis of the performance of the entire joint-use corridor during steady-state and fault conditions with the selected mitigation and prove that all concerns and issues along the pipeline route have been resolved using economical solutions.

6. **Validation by Testing**
   - Describe the various field measurement techniques that are required to validate the final design.
   - Discuss FOP field measurements typical problems and errors and how to avoid them.
   - Describe touch and step voltage measurement problems and errors and how to overcome them.
   - Safety issues and precautionary measures required during the field tests.