



# **SES Training & Certification Programs**



**Welcome to the SES Grounding, EMI and Lightning  
Academy**

**A Center of Excellence,  
Where Experts are Created and Certified**

# SES: Training You and Your Staff to Carry Out Challenging Grounding, EMI and Lightning Studies

Safe Engineering Services & technologies Ltd. (SES) provides flexible technical education services, ranging from basic to expert levels, to enhance the knowledge and skills of professionals carrying out analysis and design work in the areas of **grounding** (earthing), **electromagnetic interference (EMI)**, **lightning and transient analysis**.

In addition to training, SES provides a certification program that allows you and your personnel to prove that you have acquired a verifiable level of proficiency in the subject matter studied and thus also provides your organization with a marketing tool to show clients and potential clients that it is qualified to carry out engineering studies to the highest standards in the areas of grounding, EMI and lightning protection. As an internationally respected authority in these areas and developer of the CDEGS software package, which has become a *de facto* standard throughout the world, SES lends great credibility to organizations whose personnel have received SES accreditations.

There has been a significant increase in demand for highly skilled professionals in the areas of power system grounding, EMI and lightning protection due to the evolving energy market sector, fueled by constantly increasing consumption and reliability requirements, urbanization in developing countries, installation of renewable energy systems, and the push to meet environmental constraints. As demand increases and the nature of the work changes, it is imperative for professionals who wish to enter these fields to have access to state of the art training from an organization which can also keep them abreast of the latest developments in methods and tools as these may change over time. Having the right expertise is essential to ensuring that the electric energy industry is reliable, safe and sustainable. The experts at SES have the experience, knowledge and ongoing involvement in the latest research to prepare you for these challenges.

Since not every learning need is the same, SES offers tailored courses to meet your unique needs and requirements. The focal point of SES's customized instructor-led courses is hands-on learning, based on any of your own challenging project work that you wish to bring or SES projects that have been designed to address all important technical aspects of a study, thus allowing you to build experience from carrying out real-world projects.

SES's specialists in the fields of grounding, EMI and lightning can help you broaden your capabilities, expand your knowledge, and lay the foundation for your successful use of SES's specialized software packages. In addition to the standard training portfolio described in this document, SES also offers customized training to meet your organization's need for competency in SES's fields of expertise. By partnering with SES, you can enhance your knowledge, improve your productivity, shape your career, help your organization broaden its leadership and increase its market share.

Welcome to the SES academy of excellence in the study of grounding, EMI and lightning, where experts are created... and certified!

# Enhance Your Knowledge and Experience, One Level at a Time

The SES Grounding & EMI Academy offers a wide variety of courses, which you can attend at SES's training center, at one of your facilities, at regularly announced locations in major cities, or on-line. SES's professional staff ensures that you and your personnel are provided with the learning tools you need to become a specialist in power system grounding, EMI and lightning protection and fully utilize the extensive capabilities of SES's software solutions.

SES offers two types of training programs. The first leads to a certification, awarded by SES following a formal e-Exam, completed by the seminar participant in the presence of an SES instructor. Three certification levels are offered and the names of the individuals who pass the certification exams are published on SES's website for the entire validity period of the certification. This period varies from 4 years to 10 years, depending on the certification level, as explained below. This type of training program is quite focused and has the following attributes:

- ❖ It is delivered to a small group of students (maximum of 10 students).
- ❖ The instructor responsible for the group is a leading SES expert, with over 10 years of practical experience.
- ❖ The training is based on projects with real-world relevance.
- ❖ The course presentations are based on high-quality, comprehensive, documents and computer files.
- ❖ It is an extensively practice-oriented activity in which the student must complete a specific project.

The second type of training program is dedicated to providing the required knowledge and experience, without imposing any formal exam. A certificate of attendance along with the appropriate CEU of PDH hours is awarded at the end of the training session to all candidates who have attended the entire course.

## Training Options & Venues

Skilled and knowledgeable employees are vital for the success of leading companies. Rapid technological advancements require employees to continuously and systematically enhance their capabilities in solving real-world problems. Furthermore, many companies that wish to hire and contract skilled professionals require proof of competence that can only be delivered by a valid and reliable certification system. SES understands that combining work load with constant learning and training in order to meet these objectives is a delicate balancing act that requires flexible course options.

This is why SES offers various means to acquire knowledge, while accommodating work load constraints:

## Types of Training:

### ● **Standard Training Courses**

These courses teach the participant key concepts required to understand and carry out power system grounding, electromagnetic interference and lightning studies. This includes not only practical design concepts, reinforced with hands-on sessions with computer simulations, but also field techniques to ensure that soil resistivity, grounding grid impedance, and other related parameters are measured accurately. These courses cover the material that must be mastered for the SES Certification Level 1 and indeed, attendees may elect to participate in the exam that will allow them to acquire this certification, during such courses. There is no fixed limit on the size of standard training classes.

### ● **Customized Training Courses**

This option offers organizations complete personalization of the content, schedule, and indeed, location and number of attendees, of the training sessions. Your choice of attendees and their number can be changed any time before the session starts. The training cost is based on an agreed fixed amount per event, regardless of the number of attendees.

### ● **Certification Training Courses**

This training is designed to insure that a candidate acquires the required knowledge for the intended certification level. As there is a limit of 10 people per certification training session, it is possible to give each participant more personal attention than is the case in a standard training class. The candidate must follow a well-defined program to systematically build up the necessary expertise for the target certification level and the candidate must pass the required tests that verify the minimal competency of the candidate for that certification level. There are presently three possible certification levels, namely, **Fundamental** (Level I), **Advanced** (Level II), and **Expert** (Level III). They are described in detail further below.

## Venues:

### ● **International Locations Announced by SES**

SES periodically announces training sessions to be held in major cities throughout much of the world. These are open to individuals, who benefit by learning alongside professional colleagues from other organizations, at locations near to them, for maximum convenience and cost-effectiveness. A minimum number of attendees may be required at some locations. This venue is available for both standard and certification type training.

### ● **Customer Site**

SES instructors will travel to your site to give any type or level of training, customized to your special needs and preferred dates. The training cost is based on an agreed fixed amount per event, regardless of the number of attendees.

### ● **SES Training Center**

A visit to the SES training center provides you with not only a first-rate teaching facility in Laval, Quebec, Canada, with comfortable accommodations on the same campus, but also the opportunity to meet members of SES's research team. Fixed dates for certification type training are reserved for individual registration and announced on SES's web site. A minimum number of attendees is required. This venue is also available for organizations wishing to visit for customized training of any type or level.



### ● **Online Web Conferences**

This option offers organizations complete personalization of the content and duration of training sessions via online web conferences. The dates are selected by your organization. The number of attendees and selection of the attendees are determined by you and can be changed any time before the web conference session starts. The training cost is based on an agreed fixed amount per event regardless of the number of attendees. Note that for participants who wish to be certified, an e-Exam must be written in the presence of an SES instructor.

## **Certifications and Associated Training Programs**

The Certified Training Courses are tailored by SES based on an appropriate combination of one or several real case studies, fundamental concepts and essential analytical skills and knowledge that are required to achieve a specific competence level. The real case studies can be based on an ongoing or future candidate project that has been modified and expanded by SES (if necessary) to meet the required criteria for the certification level that is the target for the course. The advantage of using the candidate's own project is obvious, in terms of the dual purpose training and work productivity during the course.



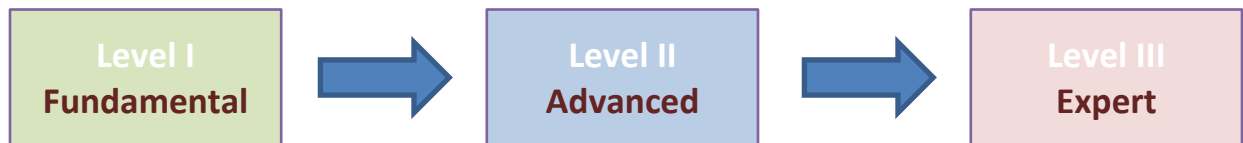
SES certifications constitute an effective manner for engineering professionals to validate skills and demonstrate knowledge and proficiency in a highly competitive market. SES certifications also provide a means of common and consistent reference for evaluating that knowledge. The mission of SES's Grounding & EMI Training Academy is to:

- Provide a proven and reliable method of training specialists in this area.
- Provide a fair, repeatable and consistent method of assessing candidates' skills and knowledge.
- Develop a pool of professionals who understand how to correctly carry out grounding, EMI and lightning studies in the electrical power industry and provide state of the art solutions when corrective measures are required.

SES presently offers three levels of certification training programs that lead to a diploma granted by SES following successful completion by the candidate of a formal e-Exam during the training period (i.e., onsite). Three certification levels are offered and the names of the successful candidates are published on SES's website to confirm the validity and authenticity of the certificate. The validity of the certification period varies from 4 years to 10 years depending on the certification level as explained below.

Each curriculum consists of a progressive set of classes with three qualification levels: **Fundamental**, **Advanced**, and **Expert**. Each level concludes with an **exam** to ensure that the training was successful.

## SES Certification Levels



Candidates progress from a conceptual understanding and an ability to evaluate the work performed by others, at the Fundamental certification level, to being able to carry out analysis and design studies using the CDEGS software package, in one of two areas of specialty, at the Advanced level. At the Expert level, the candidate is able to analyze all complex aspects of grounding, lightning and EMI issues, with the successful design of economical mitigation measures, where needed, based on sound concepts and judgment.

### Certification Level I: Fundamental

The Fundamental Certification training is designed for participants with little or no familiarity with grounding, lightning and EMI issues. Level 1 certification means that the individual understands the key concepts related to grounding, lightning and EMI studies and is therefore in a position to evaluate the validity of such studies as a manager, supervisor or client.

**Duration:** 4.5 Days.

**Certification Program Prerequisites:**

- **Practical Experience:** At least one year of work experience in electrical engineering or a degree in electrical engineering or physics.

- **Knowledge:** Good understanding of basic circuit theory and fundamental knowledge of electromagnetism (Ampere's and Faraday's laws, etc.).

**Period of Validity:** 10 years. After this period, the candidate must attend a refresher course and pass the associated exam.

**Course Description:**

During Part I of the course, the three modes of electromagnetic energization are introduced. Earth resistivity measurement and interpretation techniques are discussed, for uniform and multilayered earth. The concept of soil model equivalence and soil layer resolution is explained, based on computer simulations. The analysis and design of simple and complex grounding systems made of arbitrarily oriented three-dimensional conductors buried in multilayered soils are discussed and illustrated with practical examples. The case of grounding systems partially buried in a finite volume (e.g., backfill) of heterogeneous soil is explored. The scientific concept of earth impedance measurements using the Fall of Potential method is explained clearly based on various realistic soil models. Transmission line, buried cable and buried pipeline parameters (self and mutual impedances) in layered earth are analyzed and fault current distribution computation techniques are described. Electric safety concepts are introduced and issues involving body currents, body impedances and foot resistances are discussed for power frequency and high frequency electric exposure.

In Part II of the course, conductive and inductive interference effects caused by energized conductors on overhead and buried bare or coated metallic structures and conductors, such as pipelines, fences and communication wires are introduced and investigated in detail. Mitigation methods and equipment are presented and their relative merits are discussed. Interaction between the sources of the interference and the victim lines or circuits is examined in detail. Finally, electric and magnetic fields generated by energized overhead and buried conductors at low and high frequencies as well as during transient conditions, such as lightning strikes, are described and typical analysis methods and computation results explained.

Candidates that have elected to acquire Certification Level I must complete and pass an exam at the training session.

Upon completion of the Level 1 course, candidates will be able to:

- Understand the fundamentals of grounding and EMI as related to electric systems.
- Explain and eliminate many misconceptions, ambiguities and incorrect measurement, analysis and design techniques which still abound in the industry and are taught at some courses.
- Comprehend scientific concepts using practical examples drawn from the course material and documents.
- Recommend appropriate soil resistivity test measurements as well as Fall of Potential, touch and step voltage field measurement.
- Supervise and help technicians carry out accurate measurements using adequate equipment.
- Understand differences between various soil structure models.
- Discuss and describe the various types of grounding system configurations.
- Evaluate electrical safety concerns and be able to identify unsafe conditions.
- Comprehend the fundamental methods used in the steady state and fault analyses of electric circuits.
- Apply the complete project management steps required to complete analyses and designs of electrically small and large grounding systems.
- Understand the mechanisms of ac interference (EMI) and the methods used to mitigate their deleterious effects.

- Understand the basic concepts of lightning shielding methods and techniques.
- Understand the basics of insulation coordination and surge arrester applications that provide overvoltage protection from events such as switching and lightning surges.
- Understand the fundamental differences between fault and high frequency transient (lightning) effects on electric systems.

## Certification Level II: Advanced (Substation Grounding or EMI Specialization)

The Level II 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 II 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.

**Duration:** 4.5 Days.

### Certification Program 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 1 Certification**

**Period of Validity:** 6 years. After this period, the certified candidate must attend an updated course and pass the associated exam.

### Course Description:

There are two Advanced Certification (Level II) specializations:

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

Regardless of the specialization chosen for Certification Level II, the next certification level (i.e., Level III: Expert) focuses on topics that are not covered in Level II 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 required 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.

## Certification Level III: Expert

The Expert Certification training provides Level II graduates with the complementary Level II specialization (i.e., substation grounding or power line EMI), the ability to carry out transient studies involving power system effects on low voltage circuits and design corrective measures, and generally, mastery of use of the CDEGS software package to solve complex engineering problems. Level III graduates are recognized by SES as expert consultants in the areas of power system grounding, EMI, lightning and other transients and power users of the CDEGS software package.

**Duration:** 4.5 Days.

**Certification Program Prerequisites:**

- **Practical Experience:** At least three years of work experience in electrical engineering; alternatively, a degree in electrical engineering or physics and two years or more of work experience in electrical engineering. The candidate must also demonstrate proficiency in the Level II specialization previously chosen.
- **Level 2 Certification**

**Period of Validity:** 4 years. After this period, the candidate must attend an updated course and pass the associated exam.

**Course Description:**

This course consists of the complement to the Level II specialization previously chosen by the candidate, as described in the Level II curriculum above, as well as the following subjects:

- Calculation of the self and mutual impedances of arbitrary 3D circuits made of conductor and complex cable systems.
- Determination of interference (EMI) caused by complex energized systems on exposed low voltage circuits during fault and transient conditions.
- Study of transient performance of electric installations subjected to lightning or surge currents.
- Design of mitigation measures aimed at suppressing or reducing EMI levels.

Upon successful completion of the Expert Certification course, candidates will therefore have a well-rounded education and expertise in the areas of high voltage substation grounding, AC interference from high voltage lines and large magnitude transient interference with low voltage circuits. The participant should be able to perform complex technical tasks independently and advise others on the performance of these tasks, as well as be able to evaluate, synthesize and communicate abstract concepts and make judgments about information and validity of ideas.

Candidates for the Expert certification level must complete and pass an exam at the training session to verify their mastery of the material taught at the course. They must also be able to demonstrate their experience and proficiency in their Level II area of specialization (e.g., attendance at SES Users Group Conferences, technical reports, publications, etc.).

## How to Obtain Certification

### Step 1 - Selection of the Certification Level

Select the appropriate certification level and insure that you meet all requirements listed above for the target certification level.

### Step 2 – Selection of the Venue and Participation in Training

Select the venue, register and attend the entire training session. There are four possible options depending on the venue location and the registration type that are selected:

1. **Registration on a per Candidate basis at SES Training Center.** Individual candidates can register for the target certification levels at the published dates that can be found on SES web site.
2. **Registration on a per Candidate basis at Predefined Locations Worldwide.** Individual candidates can register for the target certification levels at the applicable locations and dates that can be found on SES web site.
3. **Group Registration at SES Training Center.** A group of candidates requests the target certification level at a mutually agreed date.
4. **Group Registration at Customer Locations.** Organizations request that a group of their employees be certified for the target certification level at a mutually agreed date at their selected location.

### Step 3 - Testing

Candidates must complete all tests for the selected level. The test must be completed during the certification level training period. Students who pass the minimum achievement levels for the test exam are granted the target certification level. If the candidate fails in achieving the required passing grade on the first attempt, the candidate can ask for a second test under the supervision of SES or elect to attend the entire or an appropriate portion of the course and carry out the test during that course.

### Step 4 - Certification

Once all the requirements for the certification have been met, SES issues a digitally signed electronic certificate, as well as printed version. The name of the successful candidate and the candidate's affiliation are listed on SES's web site throughout the validity period of the certification, thus enabling any interested person to verify the candidate's accreditation.

### Maintenance of Certification

Every four to ten years, depending upon the certification level and as described in each related section above, a refresher course and associated exam must be taken to maintain the SES accreditation.

## Additional Details

### SES Instructors

The SES Grounding & EMI Training Academy Team is a group of instructors that are predominantly SES's leading experts, with over 10 years of theoretical and practical experience. They use the latest teaching methods to facilitate acquisition of the required knowledge and maximize retention.

### Balance between Theory and Practice

Indispensable theoretical concepts are constantly supplemented by practical exercises, based on real case studies, in order to achieve maximum proficiency in the topic that is the focus of each course segment.

### **SES Course Materials**

SES's course materials are based on high-quality, comprehensive, documents and computer files, to ensure that once the training is complete, the student has all the gathered information and knowledge readily available, on appropriate computer storage media.

### **SES Training Center**

The SES training center is a modern facility equipped with state-of-the-art audio-visual equipment and five-star onsite accommodations, to maximize focus on the training activities. SES's objective is to provide its customers, regardless of their location, with access to SES's expertise.

## **Scheduled Courses**

Please visit our website at <http://www.sestech.com/Training/STCVenues.htm>