SimSEE

Serie: “SimSEE User Manuals”

Volume 1

Editor and Simulator.

Ings. Felipe Palacio, Pablo Soubes y Ruben Chaer.
Montevideo – Uruguay.
Septiembre 2019.

PREFACE.

The SimSEE platform is open source. Since its inception in 2007, different people have been incorporating improvements and new features. This makes it a challenge to keep a set of updated manuals. This manual attempts to reflect the status of the platform at November 2019. On the website https://simsee.org you can access the online version of the manual and the online help that may reflect the latest improvements and additions; version that is directly accessible when the help buttons of SimSEE applications are pressed.

Historical review.

The heart of the SimSEE platform was developed at the Institute of Electrical Engineering (IIE) of the Faculty of Engineering of the University of the Oriental Republic of Uruguay within the framework of the PDT-47/12 project of the IDB-CONICYT technological development program. The project involved the work of 2 engineers for 18 months and was completed in November 2007. Since that date, the platform has been continuously improved thanks to the financing of projects in the framework of the Research and Innovation National Agency (ANII)'s Energy Sector Fund (PR_FSE_2009-18: “Improvements to the SimSEE platform”, ANII-FSE-1-2011-1-6552: “Modeling of native energies in SimSEE”, ANII-FSE_1_2013_1_10957: “Purchasing Agendas Optimizer LNG shipments for Uruguay ”), PRONOS and VATES projects (2016-2018) for the assimilation of generation forecasts and continuous simulation of the next seven-day dispatch.

SimSEE was conceived with the philosophy of FREE SOFTWARE and with the purpose of having a platform that could serve the academic purposes of teaching, research and extension. The software is distributed free of charge under the GNU-GPL v3 license type.

SimSEE is programmed in Object-Oriented Pascal language, using the Lazarus Pascal development environment (Freepascal compiler). This development environment, in addition to being excellent, has the virtue of being free, which allows advanced users, with programming knowledge, to make improvements and develop new models on the SimSEE platform using 100% free software. The Object Oriented programming style simplifies the extension of the platform and the development of new models.

The first version of the manuals was published in September 2013, in collaboration between the Institute of Electrical Engineering of the Faculty of Engineering of the University of the Republic (IIE-FING-UDELAR), the Electricity Market Administration (ADME) and the Fundación Julio Américo Ricaldoni (FJR). The Engineers Claudia Cabrera and Lorena Di Chiara were the main authors of that first version.

This second version of the manuals is carried out in September 2019 by the Engs. Felipe Palacio, Pablo Soubes and Ruben Chaer, thanks to the financing of the Inter-American Development Bank (IDB) to update the manuals and translate the manuals and applications into English.

Acknowledgement.

I especially thank my wife Alicia Butler who spent many hours reviewing and improving the Spanish text and its translation into English and the publication of the content of the manuals on the web.

Eng. Ruben Chaer / Instituto de Ingeniería Eléctrica - FING - UDELAR.
September 2019 - Montevideo - Uruguay.

Content.

1. Introduction. General Description of the Platform.

SimSEE is the acronym for "Simulator of a System of Electric Enegy".

It is a platform for Simulation of Electric Energy Systems, by platform meaning a set of tools and models, which allows to build a custom simulator for each case study.

This introduction shows in general the type of problem that implies the optimal operation of an electric power system and the architecture of the SimSEE platform as a tool for that objective.

These are the SimSEE User Manuals, so the detailed description of the resolution algorithms and the operation of the energy systems in detail is beyond the scope of this document. That knowledge is acquired in engineering graduate and postgraduate courses and with professional practice.

This is **Volume 1** of the "SimSEE User Manuals" series.

Chapter 1 contains a general description of the platform to make the user familiar with the terminology used.

Chapter 2 describes the procedure necessary for the installation of SimSEE.

Chapter 3 is the User Manual of the SimSEEEditor application, which is the most used by users and from which they access to almost all the functionalities of the platform.

Chapter 4 is the User Manual of the SimSEESimulador application, which is the one that carries out the optimization and simulation calculation work.

The other volumes of the "SimSEE User Manuals" are designed to facilitate the user access to the reference information when working with the platform.

In **Volume 2** the Sources are detailed, in **Volume 3** the Actors and in **Volume 4** the tool for post-processing of results "SimRes3".

Volume 5 is the User Manual of AnalisisSerial, an application that is used for the creation of stochastic models to be used in SimSEE.

Volume 6 is the User Manual of the OddFace application, applied to the optimization of investments in generation.

1.1. The uses of SimSEE

The uses of SimSEE can be very varied, for example:

- Programming the dispatch of resources in the medium and short term.
- Calculation of the economic result of different possible scenarios for long-term system expansions, expected physical and economic results for the

behavior of different interconnections, spot markets and international contracts.

- Analysis of the convenience of different ways of marketing the energy of a generating plant: for example, through contracts or in the spot-mode of the electricity market.
- Modeling of short-term dispatch, with the possibility of including exchange limits between areas as a way to incorporate transmission restrictions in the energy dispatch.
- Estimation of the probability distributions of energy surpluses and their costs based on the available forecasts of resources, which allows future offers to be made.
- Estimate of the annual budget for supplying electricity demand.

1.2. Overview and terminology.

The SimSEE platform is designed and implemented 100% Object Oriented. In this sense, it should be thought of as a “toolbox” that allows you to easily assemble an environment (Playroom) where objects (Actors) that know how to behave in that environment are placed. As it is a platform for simulation of Electric Energy Systems, Actors have to know how to respect electrical restrictions (for example, the sum of the powers in a bar must be zero) and know how to collaborate in the mission of the system, which is to comply with supplying the demand at the lowest possible cost in acceptable quality conditions. While this feature of the implementation is transparent to the user, it is good to keep in mind that it is this implementation philosophy that guides the nomenclature used in the description of the platform.

Simply said, SimSEE is useful for assembling simulators of the optimal operation of a System of Electric Energy (SEE). The simulators allow us to observe what the optimal operation of the SEE would be in a **time horizon** or simulation window. As it is a simulation based on computational calculations, it is carried out at time intervals or **simulation steps**. Depending on the Analysis Horizon, the simulation time-step should be set at appropriate values. For example, for long-term simulations (horizons of tens of years) it is probably convenient to use daily or weekly steps, while for short-term simulations (horizon of less than one month) surely an hourly simulation step is appropriate.

Basically there are two types of entities, based on which the model of any electro-energy system in SimSEE is assembled. These are the **Actors** and the **Sources**. The Actors are entities that know how to handle energy in some way (for example, Generators and Demands of electric energy). The Sources are entities capable of generating numerical values (eg. price of a barrel of oil, wind speed, etc.) that can be used by the Actors and other Sources.

As it is about performing simulations over time, the parameters of these entities may change over time. Entities may even appear or disappear during the analyzed time horizon. To support this possibility of temporary variation of the entities and their parameters, the concept of **Dynamic Parameter Records** is implemented in SimSEE. As you can see, different sets of Dynamic Parameters can be defined for each type of entity.

To carry out a simulation, we must create the different Actors that will participate in it and place them in a **Playroom** (or simply Room) which is the environment where the simulation will take place. Each Room is stored in a file with the extension ".ese" by default.

The three most important applications of the platform are the Room Editor "SimSEEEdit", the Optimizer/Simulator "SimSEESimulador" and the post-processor of results "SimRes3". These three applications are referred to in abbreviated form as the **Editor**, the **Simulator** and the **SimRes3** respectively.

The Editor allows to add, remove and modify the Actors of a Room in a friendly way and launch the Simulator application from the same environment to perform the simulation of the Room and the "SimRes3" application to post-process the results.

Since the systems considered have stochastic processes (for example the hydraulic contributions to the dams or the state of breakage/repair of the machines) that make the result of the simulation itself a stochastic process, in the simulator it is possible to simulate many realizations of stochastic processes (i.e. "possible stories"). Each realization of simulated stochastic processes is called Simulated **Chronicle**. For example, if 10 years of the system are simulated with a daily time step, the power dispatched by a given power station in one of the simulated chronicles can be observed as a 10x365 value serie. If 100 chronicles are simulated, 100 series of 10x365 values will be needed to represent the same observed variable. This set of values that represent a magnitude, can be thought of as a matrix, with time in the rows and the chronicles in the columns. This representation of a magnitude is called in SimSEE "Chronicle Variable" or **CronVar** in abbreviated form.

To be able to visualize and perform calculations directly with the CronVars, SimSEE has a post processor of chronic results that is the SimRes3 application. This application is able to take the simulation results and manage them to perform additional calculations and present them in graphs and plain text sheets. The SimRes3 application Manual is the subject of Volume 4 of this series of manuals.

The Actors are classified into: Network, Demands, Generators, and Others.

The Network Actors are Nodes and Arcs.

The Nodes are places of connection of Actors. At all times the sum of the energies injected into a Node must be zero.

The Arcs are directional connections between the Nodes that allow to easily represent limits of interconnection between areas of the system.

The Demands represent the demands of electric energy. They are able to extract energy from the Node to which they connect. There are different types of Demand models that allow different ways of representing issues such as projection in the years, daily and hourly variability and the costs associated with different rationing levels.

The Generators represent the generating plants. They are able to inject energy into the Node to which they connect. The main models of actor-generators included in the platform are: hydroelectric power plants with reservoirs and without reservoirs, fossil fuel-based power plants, pumping stations, wind farms, thermo-solar collectors, interconnections between countries and photo voltaic generation power plants.

In Other Actors, the models that are not included in the previous ones, such as models of International Markets, Battery Banks, Models of Manageable Energy Uses, etc. are grouped.

In the context of SimSEE, Optimum Operation is one that guides the system in order to supply the Demand at the lowest Future Cost. The operation of the system is a continuous process and we can express the above by saying that the System Operator must, at every moment, perform the operation (dispatch of the different resources) in order to ensure the lowest expected value of the future operation. Since there are energy reservoirs in the system (hydro-power reservoirs, for example), the System Operator has the option of using the energy stored in the present, avoiding other use, but eliminating the possibility of using such energy in the future (it makes the present cheaper at the expense of the future) or conversely, decide to store a resource for future use incurring the cost of using an alternative resource in the present. It is this competition, between the cost of the present versus the expected value of the future operation, that makes the problem of resolving the optimal operation policy not as trivial as simply dispatching at all times the resources of lower variable cost to cover the demand.

The costs incurred by a power generation system in order to supply its demand are essentially composed of:

- Variable operating costs of thermal power plants (fuel and the variable part of O&M).
- Energy import costs minus income from energy exports.
- Rationing Costs, defined as the costs for the economy of the country due to the failure to supply the demand (cost of failure).

The Future Cost of the system, over time, is the sum of the costs minus the aforementioned income from the beginning of the given time step until "The End of Times".

The set of rules that allow the operation of the system is called **Operation Policy** (OP). In practice, this set of rules implies giving a value to the storable resources that allow comparing the convenience of using them or storing them at each time-step. That valuation of the storable resources is variant in time and in the state of the system. The stochastic characteristic of the system (machine failures, rain, wind, temperature, etc.) makes the OP a statistically valid indication, but there is no certainty that it is the best when it is observed after the events occur. In other words, if you look to the past and judge a OP based on reality (that is, which were the machines that were really available, what were the real rains and the available wind energy, etc.) , you will surely find an operation that could have been done better if all the information had been known in advance.

Summing up the above, the optimal operation of the system can be considered as an optimization problem whose objective function is to minimize at all times the expected value of the cost of the future operation, that is, simply to minimize the Future Cost. Once the optimization problem is resolved, “The Optimal Operation Policy (OOP)” is available.

In the simulation of the optimal operation of a system with SimSEE, two stages can be distinguished: **Optimization** and **Simulation**. During the Optimization, the problem of finding “The Optimal Operation Policy (OOP)” is solved. During the Simulation, the OOP is used to carry out simulations of possible realizations of the set of stochastic processes that affect the system.

A Simulation of a Room can be of one or more Chronicles, and to be executed it needs that the Optimization stage of the same Room has been previously executed. The sequence of stages Optimization-Simulation is called a **Run**.

In practice, neither optimization nor simulation is possible for an infinite **time horizon** (or until the End of Times). An approximation is to consider a time horizon long enough to be able to assume that the sum of costs considered is representative of the Future Operating Cost. Normally a discount rate of money (10% per year for example) is used, which means that the weight of the costs, in the integral to calculate the Future Cost, decays exponentially with time and therefore removes relevance to extend the “final time” considered in values where the weight of the discount rate makes costs irrelevant.

The user must set a time horizon or time interval specifying the **Initial Date** and **Final Date**, both for Optimization and Simulation.

For the purpose of calculating based on the models of the evolution of the system, both for Optimization and Simulation, the time horizon is discretized in Stages or Time Steps. At each time step, SimSEE will calculate the evolution of the system based on the State of the system at the beginning of the step, and the realization of the stochastic processes (machines-failures, flow rates of contributions to hydroelectric plants, etc.) dispatching the different resources to comply with the energy balance of each System Node (ec. 1) and minimizing the Future Cost.

$$\text{Demand} = \text{Generation} + \text{Import} - \text{Export} + \text{Rationing} \qquad \text{ec.(1) Energy balance.}$$

SimSEE has the possibility of working with a sub-partition of the Time Lapse in **Time-Bands**. This sub-partition implies a classification of the hours of the passage of time based on the level of demand of the system, grouping the hours of greatest demand in the first Band (Peak Band), the hours of lowest demand in the last band (Valley Band) and distributing the rest of the hours according to their level in the respective bands.

The energy balance (ec.1) is verified in each of the bands of the passage of time. In the electrical system, rather than the energy balance, the power balance must be fulfilled, that is, instant by instant. The solution of setting a time step and bringing the balance of power to energy is a simplification. The division in bands allows to fix, within the passage, bands sufficiently narrow (of short duration) so that the power balance restriction is well represented by the energy balance. For example, for simulations with a weekly step, the peak time-band is usually chosen for a duration of 4 hours to represent the peak power of working days. If the power restrictions must be faithfully represented, the user must use a time step and a single band.

The user must then specify the number of bands in which he wishes to sub-divide the time step and duration of each of the bands. The sum of the hours of the bands will be the length of time. Within each band, constant values of generation power and demand are assumed.

1.2.a) Sources and terminals.

In SimSEE a **Source** is an entity that makes available values in its Output Terminals to be used by the other entities (Actors and Sources). The word “Terminal”, tries to give the idea of “connection terminal” as in a circuit, and that is why it is said that the Actors and/or Sources that want to make use of the values of a source, “connect to one of its terminals”. Most of the Sources are of a single terminal (that is to say they make available a single series of values) but there are some that generate several series simultaneously and make them available in a set of terminals (terminal block).

There are a variety of predefined source models that can be used to generate different functions (eg of constant values per time segment or sinusoids). There is another variety of sources that allows you to compose an output based on other sources (eg adders, comparators and multipliers). Another important group of sources is the set of random sources that allow generating values with different functions of probability density and modeling stochastic processes with a good degree of detail.

To fix ideas, a typical use of sources is the indexation of fuel prices of thermal power plants. For this, a source is created that generates an index to be applied to the price of fuel, giving it the desired variation in the simulated time horizon. Thermal Generators whose fuel corresponds to the index created by the source, can "connect" to the source so that their production cost is affected by the variation in the price of their fuel.

1.2.b) Layers and Scenarios.

The SimSEE Room has the possibility of having several Layers. The default Layer is 0 (Zero). When editing a Dynamic Parameter Record you can indicate the layer to which it belongs.

This Layers mechanism allows to set up different scenarios or cases. A Scenario is defined by indicating which are the Layers of the Room that are active in that Scenario. In this way, when executing the Simulation / Optimization stages of the Room, indicating a Scenario, only the Layers that belong to the indicated scenario can participate in the execution. This Scenario mechanism can be seen as a way to analyze many Cases with the same Room (the same Room file) without having to create several files and thus facilitating the maintenance of the information.

1.2.c) Dynamic parameters.

To create Actors or Sources in SimSEE, the first step is to select the type or model that best represents it. The second step is to configure the entity through specific forms of the selected type that allow setting its parameters. Once the model to be used is selected, there is usually a set of static parameters that are changed in a main form of the entity and another set of dynamic parameters that can vary during the time horizon. The dynamic parameter set is edited by means of a form in which, in addition to the parameter values, the date from which these data are valid is indicated. An instance of dynamic parameter values with its date is called the Dynamic Parameter Record. During the editing of the Room, the user can add as many Dynamic Parameters Records as he wishes to represent the evolution of the entity over time. As an example, the availability factor of a generator can vary depending on its useful life and the maintenance routines to which it is subjected.
For details on editing dynamic parameter records see the section Error: no se encontró el origen de la referencia.

1.2.d) Units.

Given an Actor, it can be indicated that it has more than one Unit. For example, if we configure a 2 MW wind turbine, indicating that the Actor has 25 units, we will be representing a 50 MW park. The Units are also dynamic parameters, which allows to remove units to represent the dismantling of a plant or to add Units to represent the incorporation of new units. In addition to the number of units, you can represent how many are in scheduled maintenance.

The possibility of representing the units within the Actor instead of varying their power, allows a fine handling of both programmed and accidental availability. Returning to the example of the park of 25 wind turbines of 2 MW, if an availability factor of 0.95 is assumed, it is not the same to model the park as a single unit of 50 MW than as 25 of 2 MW, because in the first case when the unit undergoes a fortuitous breakage, 50 MW of the system will be lost, while in the second case, the accidental breaks of the units are independent and therefore the effect of the unavailability on the real power available for the system is filtered (damped) by the number of units

1.3. Systems without dynamics.

It is said that a system has no dynamics when the history of the system is not relevant for the determination of its future evolution. Equivalently, we can say that the system "has no memory" or "has no inertia."

In a system without dynamics, the operator's actions have consequences only in the passage of time in which they are executed and do not affect possible future operations. If the variable cost of each resource was known, the most economical dispatch would be the one obtained simply by ordering the resources, at each time step, from the most economical to the most expensive (for its variable generation cost expressed in USD / MWh) and in each band, according to the level of demand of the band, starting with the most economical and continuing with the following until reaching the power of the demand.

This could be the case of a purely thermal system, in which it is easy to determine the cost of production of each unit (for example aeroderivative turbines and engines). For this to be possible, no component of the system must impose restrictions that imply a temporary linkage of decisions. Most real systems have dynamic restrictions (which link several time steps) and therefore the Optimal Operation Policy is more complex than simply dispatching in order of increasing production variable costs. Just as an example, in a system where the lower variable cost central was a combined cycle that requires 4 hours of purging and heating the boiler and steam cycle to achieve the combination, even if it is the lower variable cost central, it would not be the candidate for the coverage of a power peak hour of the system.

1.4. Dynamic systems.

Dynamic system is understood as one in which the history of the system is relevant to its future. Equivalently it is said that systems with dynamics have "memory" or that they have "inertia".

The operation of a system is continuous decision making. From the definition itself, it appears that in a dynamic system, the decisions of the present affect the future and therefore when trying to make an “optimal operation” the past must be considered for its consequences on the present and, from the set of possible decisions, considering that past , take those that lead to a lower cost of both the present and the future.

Real systems have inertia that make it necessary to consider them as dynamic systems. For example, they include energy stores such as reservoirs of hydroelectric power plants that create a temporary dependence. A volume of water that is used now to replace a thermal generation (and thus save the cost of fuel associated with the replaced energy), cannot be used in the future unless it rains and is replenished. Another example of a temporary (or dynamic) link is the slow-start thermal power plants that impose restrictions on imposing an inflexible dispatch. An example of a dynamic link is a base plant like a nuclear power plant. A power plant of this type does not accept power variations quickly (they are intended to be dispatched “at the base” of the demand curve).

The resolution of dynamic systems requires the valuation of storable resources, such as water in hydraulic reservoirs, which does not have an explicit cost. The valuation consists in calculating the value of the resource by its ability to avoid future costs. This valuation is used later in the solution of the economic dispatch in each Time Step.

The **State** of a system is defined at a given time, as the relevant information of the system's past. Knowing the State implies knowing everything necessary from the past that determines the possible actions present and the possible evolution of the system. Once the State is known, it is possible to calculate the evolution of the system with the knowledge of future events.

The Optimization takes into account the set of state variables that model the fundamental aspects that we are interested in observing of the electrical system. The status variables can be continuous (eg volumes of hydroelectric dam reservoirs, volume of fuel stored in a tank) or discrete (eg on / off of a thermal machine that has a specified start and stop cost).

Optimization is carried out by Stochastic Dynamic Programming (PDE). The result of it is a function $CF(X,k)$ with the expected value of the Future Cost of operation of the system for each value of the status vector X and every time step k . This function is also known as Bellman's value function.

The relevant information for decision-making (The Optimal Operation Policy) is found in the directional derivatives of Bellman's function.

For the ith component of the state vector, said directional derivative would be: $\frac{\partial CF}{\partial x_i}(X,k)$.

Note that this derivative allows to assess the use of the resource associated with the state variable x_i quantifying the effect on the future of making a decision that implies in the present (instant k) a variation δx_i in the state variable x_i .

SimSEE provides support for the management of the Bellman function, for its calculation and for the calculation of its derivatives in a transparent way for the common user, and very useful for users who intend to develop new models to add to the platform.

1.5. Modeling an electric power system.

1.5.a) Representation of the transport network.

For the modeling of the network in SimSEE, Actors of the **Node** type are available to which the other Actors are connected, and of the **Arc** type or energy transport corridors that connect nodes. The Nodes are simple connection bars, the Arcs allow you to specify performance, toll, transport capacity and availability factor, thus allowing to represent transport restrictions between the different areas of the system considered.

Just as an example and to set ideas, Fig. 1 shows a scheme of a system with two nodes joined by two transport corridors. The G1 generator and demand D1 are connected to Node_1 and G2 generator and D2 demand to Node_2.

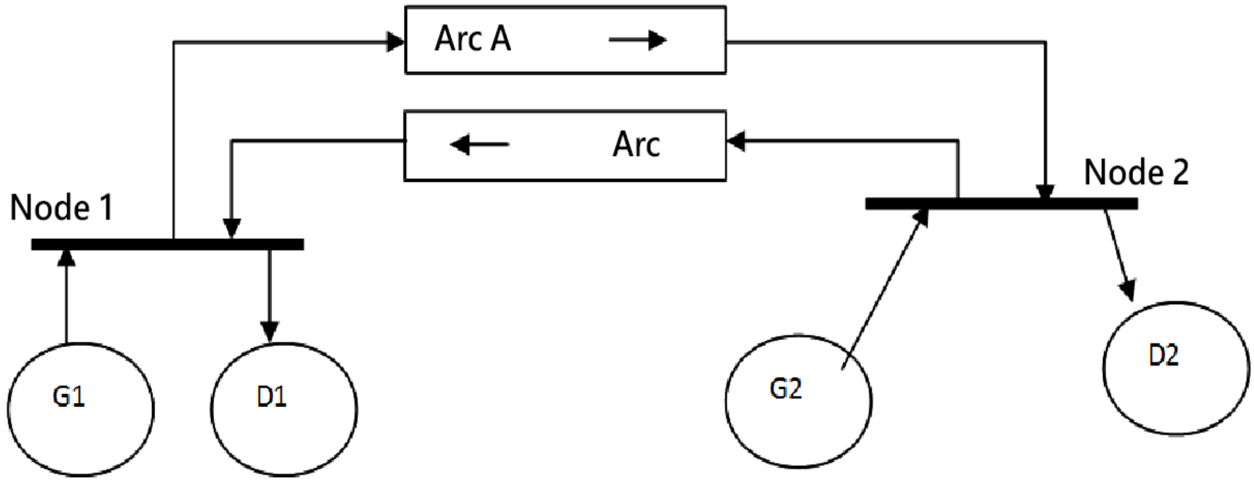


Fig. 1: Representation of the transport network.

1.5.b) Node Restrictions.

The **Power Balance** (“Node Restriction”) must be instantly fulfilled in each NODE, that is, the algebraic sum of the powers injected into the node must be ZERO.

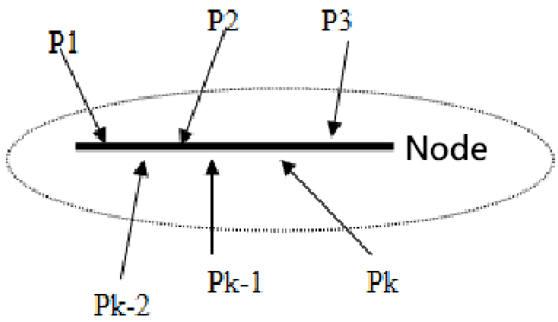


Fig. 2: Node restriction.

1.6. Chaining Playrooms.

The search algorithm of an Optimal Operation Policy implies the exploration of the future to determine the consequences (the value) of the use (movement of the State) of a resource in the present. As it is not possible to explore to infinity, in practice a horizon is assumed from which the affectation of the future is NULL. This assumption is possible in practice for two reasons: 1) by using a discount rate to update costs, the future in the very long term has negligible present value and 2) the very nature of the system, with energy stores that saturate (eg reservoirs can store up to a maximum volume and then end up pouring water) and the randomness of resources that causes the consequences to be diluted over time. Assuming a NULL affectation from the end of the Optimization Horizon implies that the simulated operation, when it approaches the end of the Horizon, will make use of the stored resources assuming that they have no value from the end of the Horizon (for example this implies an emptying of the lakes in the system) and for this reason, the Optimization Horizon must include the Simulation Horizon leaving a margin between the end of the Simulation and the end of the Optimization. This margin between the end of the Simulation Horizon and the Optimization Horizon is known as the Optimization Guard Horizon and the necessary duration of it depends on the structure of the system under analysis.

It is common to use more than one Room to describe the same system according to the Horizon of analysis. For example, a Long Term Room with a horizon of tens of years and a weekly simulation step, a Medium Term Room with a horizon of months and a daily simulation step and a Short Term Room with a horizon of weeks and a time simulation step. If the Optimization Guard Horizon required by the structure of the system is 3 years, it would be very expensive to impose that guard in the Short Term Room (time step) and then simulate only a few weeks. For this reason, it is convenient to have a mechanism to transfer information about the consequences of the future already explored by the Rooms with the greatest optimization horizon between the Rooms.

The Rooms can be chained so that the Optimization stage of one, instead of initiating the Stochastic Dynamic Programming algorithm without information at the end of the optimization horizon, does so by “looking at” the Future Cost function of the Room to which it is attached.

Fig.3 schematizes the coupling of the Future Cost functions of the 3-Room example mentioned above.

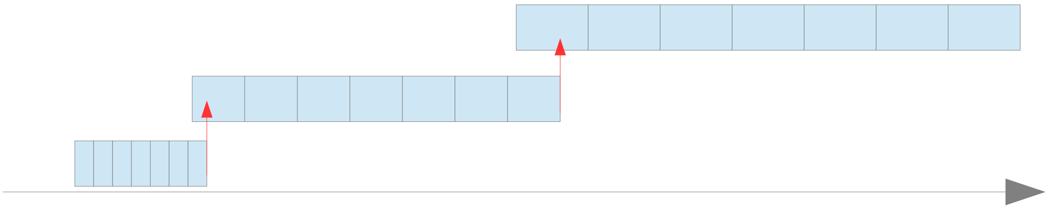


Fig. 3: Optimization Horizons of 3 chained Rooms.

The status spaces of the chained Rooms do not have to be the same and tend not to be, for the simple reason that when going to the present and wanting to perform more detailed simulations with increasingly smaller time steps, new state variables become relevant that were not relevant over time.

A practical example of this is the use in the Uruguayan system. In the weekly long-term Rooms, only the Rincón de Bonete lake reservoir is considered relevant, and the lake level is used as a state variable. In the medium-term rooms of daily passage and month horizon, the level of the Palmar lake is introduced as the second important lake of the system, and in the short-term Room of hourly steps and 15 days horizon, the level of the Salto Grande lake is introduced.

The “new” variables in the room that is chained are considered “without information”. Only for the matching variables the information (partial derivatives) of the chained rooms are “transmitted”.

It may also happen that an existing state variable in the chained Room disappears in the chained room. As an example, if a state variable is "very heavy" and can be considered constant in the short-term room, it makes no sense to consider it as the state variable of that room but it can be considered in the medium-term room. In this case, it is necessary to specify when chaining the Rooms in which value of the variable that disappears the coupling must be performed. It is also allowed to specify that the values of the variable are averaged instead of specifying a specific value.

2. Installation Procedure.

This section describes in detail the process for installing the SimSEE program on your computer.

2.1. Download website.

You can find the latest version of the installation program at the following web address:

https://simsee.org/downloads.html

Simply download the corresponding compressed file from Windows or Linux depending on your operating system and unzip its contents in the folder {$HOME}/SimSEE/bin, where {$HOME} is "C:\" if your operating system is Windows and your User folder if it is on Linux.

The user can select another location to install SimSEE, but it is recommended to respect the location suggested in the previous paragraph to facilitate compatibility with the reference to external files that the created Rooms may have and shared by users.

By default, the application language is Spanish. If you want to change the language, run the SimSEEEdit application and in the main menu select "Language". A message will appear indicating that the change was made and that for it to take effect you must close and reopen the application.

2.2. SimSEE folder structure. Description of the content.

The first time you run SimSEEEdit, the folder structure is created under the {$HOME}/SimSEE directory shown in Fig.4:

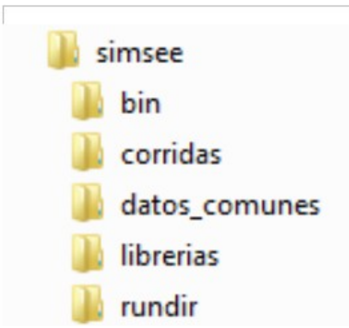


Fig. 4: SimSEE folder structure

The content and purpose of them is described below:

- **"bin"**: SimSEE executable programs, configuration files and language files are stored in this folder. The main applications are the SimSEEEdit Room Editor, the SimSEESimulator optimizer/simulator, the SimRes3 results post-processor. For more information see section 2.3 "SimSEE Binaries".

- **"corridas"**: Generally, in this folder are the sub-folders of the different Rooms executed. One way to organize the work is to create a new sub-folder of the folder "corridas" for each study that is carried out and in that folder all the rooms related to the study are stored. This is the suggested organization, but it is not mandatory and the user can save the Rooms in any folder.

- **"datos_comunes"**: In this folder some common data is stored so that they can be used in different rooms. For example, the models of generation of water-flows to the dams of the country based on historical series, models of wind-power generation based on historical wind series, detailed demands of historical years, etc.

- **"librerias"**: Actors and Sources are saved in this folder when they are exported from a Room. Each Actor and / or Source is saved in a separate text file and can be subsequently imported from another Room.

- **"rundir"**: When performing an Optimization or Simulation with the Simulator, a folder is created within the "rundir" folder in which the files with results of the Run are stored. If there is no sub-folder under "rundir" with the same name as the room under execution, it is created at the start of execution. If the folder already exists, the results contained therein will be overwritten. The files generated when executing a run are usually of a considerable size, so it is recommended to check the folder every now and then to delete the subfolders that are no longer being used, to avoid taking up excessive disk space (to regenerate them, if necessary, you must execute again the run). In Fig.5, the folder "rundir" is marked on the left side and on the right side, a Room that has been executed whose name is "sala_de_prueba" is shown .

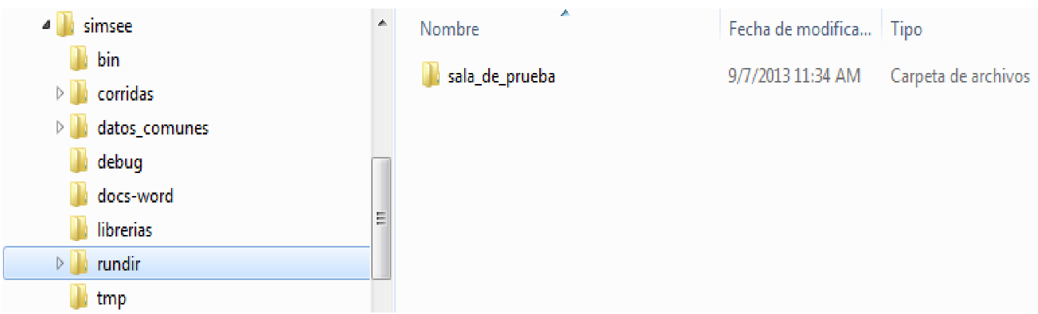


Fig. 5: Results folder "rundir".

It can be seen that, once a run is executed, the system adds some auxiliary folders to the basic folder structure: debug, docs-word and tmp, which are folders used in an accessory way by the software to save intermediate results, among other uses .

2.3. SimSEE Binaries.

The following executable programs are found in the “bin” folder of SimSEE installation:

- **“SimSEEEdit”**: SimSEE editor through which the user can create and edit Rooms and post-processing sequences of the results as well as launch optimizations/simulations. Its main menu is described in the Chapter 4. Editing a simulation consists in selecting the Actors that will participate in the Game and adding them to the Playing Room.
- **“SimSEESimulador”**: the optimizer / simulator that will be invoked by the Editor when the user has finished editing the Room and decides to optimize and simulate it (do the Run). It is described in the chapter Chapter 4 of the present Manual.
- **“SimRes3”**: the program that allows the user to perform different post-processing calculations of the results obtained in the simulation. It may be invoked by the Simulator once the corresponding simulation is finished and from the Editor itself if the simulation has already been performed. Its detailed description is found in Volume IV of the SimSEE User Manual series.
- **“analisisserial”**: It is an auxiliary utility to the platform that allows analyzing time series of data and creating a correlation model in Gaussian Space with CEGH Histogram. The program “**analisisserial**” is explained in detail in Volume V of the SimSEE User Manual series.
- **“cmdopt”, “cmdsim”**: command files that allow the execution of the Optimization and Simulation stages respectively. These programs do not have a graphical interface and must be called by passing as parameters the Room to be executed and other necessary data. These executables are useful for scheduling the execution of run sets in BATCH mode on either Windows or Linux. They are also the same executables that are used for the execution of SimSEE in high computational performance equipment in which the execution is carried out remotely without access to graphical interfaces.
- **“datosbin2xlt”**: It is an auxiliary utility that allows you to convert a detailed time file in binary format (extension .bin) to a plain text file using the tab character as a separator (extension .xlt) in order to be able to visualize its contents (eg to visualize the SimSEE demand files).

- **“oddface_prepare”** and **“oddface_pig”**: These are applications that allow you to prepare optimizations for optimal generation plans and execute them. They are described in detail in Volume VI of the SimSEE Manual series.

3. The Rooms Editor.

The information of a SimSEE Room can be classified as:

- Description of the Temporary Horizons.
- List of Actors and Sources.
- Specification of values to register and their postprocessing.
- Scenarios Description.
- Additional parameters for execution.

This chapter describes the previous contents and the way in which they can be edited.

3.1. User interface unified methods.

This section presents general characteristics of the editor that are applied in various types of editing. Generally, all the information of the Room is organized in lists of entities (Actors, Sources, etc.). The editing work mainly involves: Add / Remove entities from the lists and Edit the parameters of the entities.

3.1.a) Form editing.

Whenever the editing of an entity begins, in SimSEE the entity is "cloned" and a form is opened that displays the current values and allows them to be modified. These forms have a "Save" (or Save Changes) button and another "Cancel" button. If you press the "Save" button (see example in Fig. 1) the new set of values will be copied over the originals, if you press "Cancel" the new set of values will be discarded without modifying the originals.

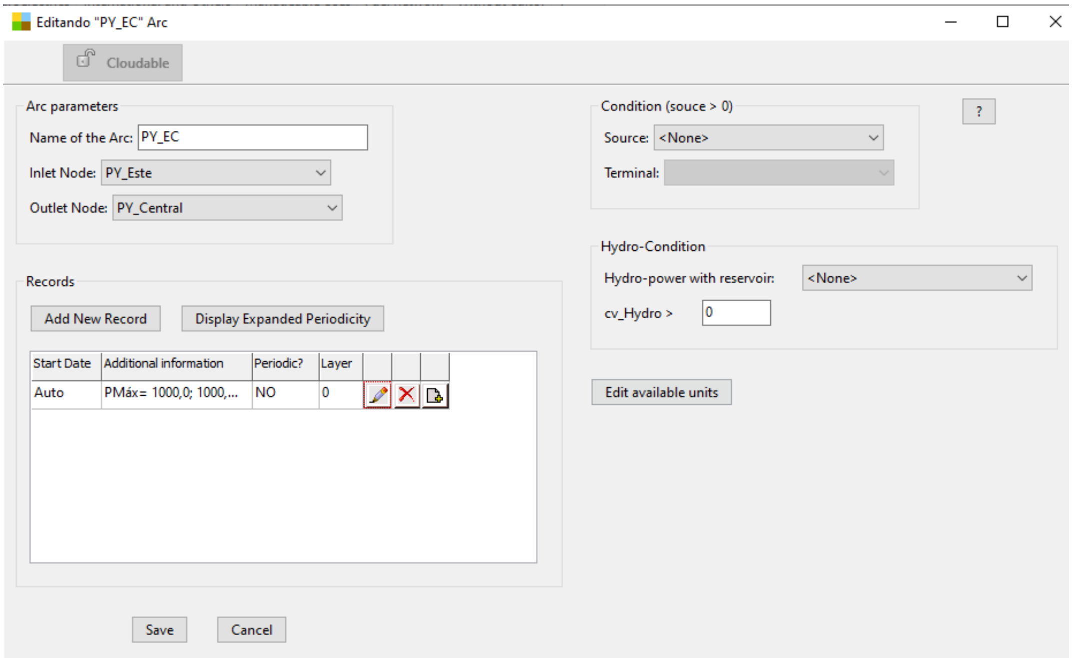
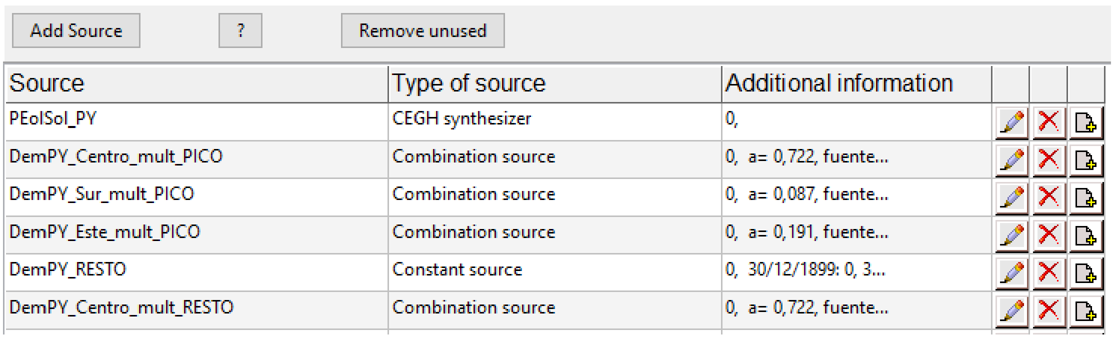


Fig. 6: Example of editing form.

3.1.b) Management of listings.

In the Editor, whenever it is possible to edit listings (eg Actors, Sources, dynamic parameter tabs of an entity) they are presented by means of tables embedded in the forms, as the example shown in Fig.7. At the top of the table there is a button that allows you to add a tab (record) to the list. In the example in Fig.7 this button is “Add Source”.



Source	Type of source	Additional information
PEolSol_PY	CEGH synthesizer	0,
DemPY_Centro_mult_PICO	Combination source	0, a= 0,722, fuente...
DemPY_Sur_mult_PICO	Combination source	0, a= 0,087, fuente...
DemPY_Este_mult_PICO	Combination source	0, a= 0,191, fuente...
DemPY_RESTO	Constant source	0, 30/12/1899: 0, 3...
DemPY_Centro_mult_RESTO	Combination source	0, a= 0,722, fuente...

Fig. 7: Example table for editing a list.

The first columns contain a summary of the values of each record. The columns on the right with the buttons are the ones that allow modifying the list. The meaning of the buttons is as follows:

 "Pencil": Opens a form that allows you to edit and modify the values of the record.

"Cross": It allows to eliminate the record. A window opens asking for confirmation to proceed with this removal. On the other hand, if the file is being referenced by another entity, a window is opened that warns of this, and informs that therefore its elimination is not possible.

"Clone": Clones the record. Pressing this button creates a copy of the selected record and opens the editing form on the new created record. It is useful to create a new file from an existing one, avoiding having to enter all the data again.

3.1.c) Editing a Dynamic Parameters Record.

Each Actor or Source has its own type of Dynamic Parameters Record with its set of specific parameters. All types of Dynamic Parameter Records have in common the parameters that appear in the form in Fig.8.

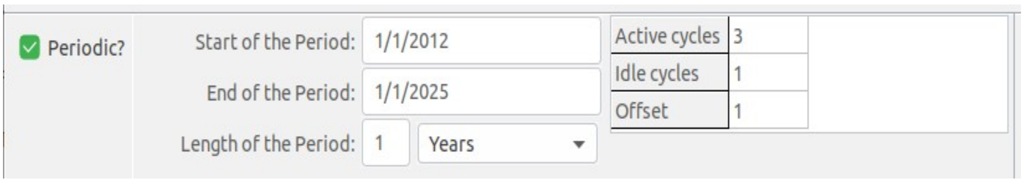


Fig. 8: Dynamic parameters records.

The "Date" indicates from which date the Record is valid. The word "Auto" or a 0 (Zero) indicates that the record is valid from *the beginning of time* (or what is the same, since the beginning of the Horizon).

The "Layer" allows you to specify in which Room Layer the record is valid.

The "Periodic?" Box allows you to indicate whether the Record should be considered periodic or not. If unchecked, the record is not periodic and is valid from the indicated Date. If the box is checked, the panel that allows the specification of periodicity is expanded, as is shown in Fig.8. If a Record is periodic, it represents a train of records, one of which is placed on the specified Date. The records will be separated from each other for the time indicated in "Length of the Period" (1 year in the example in Fig.8). "Start of the Period" and "End of the Period" determines a time window (Horizon Filter) in which the records in the records train are valid.

In addition to that Horizon filter, the "Active Cycles", "Inactive Cycles" and "Offset" parameters allow a "cadence" (Cadence Filter) within the train of registers. In the example, "Active cycles = 3", "Inactive cycles = 1" and "Offset = 1" that indicate that there is a cadence of three active records followed by one inactive and then three active and one inactive Repeat indefinitely beginning the first active record one year after the "Date" value as set by the Offset parameter. This cadence filter allows modeling situations such as scheduled maintenance of generation plants. Generally, the plants have regular maintenance every year and special maintenance once every four years in the example. The "Offset" parameter allows you to indicate how many steps (records) the first active record is in relation to the starting “Date”.

In the “Date” and “Start Of Period” a value of “0” (cero) means that the value considered will be the start of the Optimization Horizon.

The configuration and use of the periodic records has proved difficult to understand and use by users. To try to reaffirm the topic, three examples of using periodic files are presented below.

3.1.c.i Example 1

As an example, to schedule a plant to be serviced every year for 1 month in September, two periodic records are needed. One, to remove the unit and another to re-establish it a month later. In this case, the starting Dates would be 1/9/2013 and 1/10/2013 respectively, both records would have the “Periodic?” box marked and Long Period 1 year box marked. In the horizon filter the two values would be set to Auto or 0 (Zero), to indicate that it is from the beginning of the times to the end of the times (that is, throughout the entire analysis horizon). The cadence parameters would be set to "Active Cycles = 1", "Inactive Cycles = 0" and "Offset = 0".

To give an example in which the cadence filter makes sense, imagine a case in which the two records of the previous paragraph define the regular maintenance of the plant, but that once every four years it is necessary to do a major maintenance that lasts 4 months and you want to start in August. To achieve this, two more records that model the major maintenance must be added and the two records in the previous paragraph must be given cadence. The two records that model the major maintenance would have dates 1/8/2013 and 1/12/2013, “Period Length = 1 year”. The horizon filter with the two values in Auto. The cadence parameters would be: "Active Cycles = 1", "Inactive Cycles = 3" and "Offset = (N-1)" with the value of N explained below. To the two records of the previous paragraph we must change the cadence parameters that would be: “Active Cycles = 3”, “Inactive Cycles = 1” and “Displacement = (N-1) +1” to ensure that the beginning of one of the groups of three active records one year after each major maintenance. The value of (N-1) sets when the major maintenance is compared to the date 1/8/2013. If (N-1) = 0 then there is a major maintenance in 2013, if it is 1 in 2014 and so on respectively.

3.1.c.ii Example 2.

Fig.9 shows one of the dynamic parameter records of an actor that represents the possibility of importing energy in a Room.

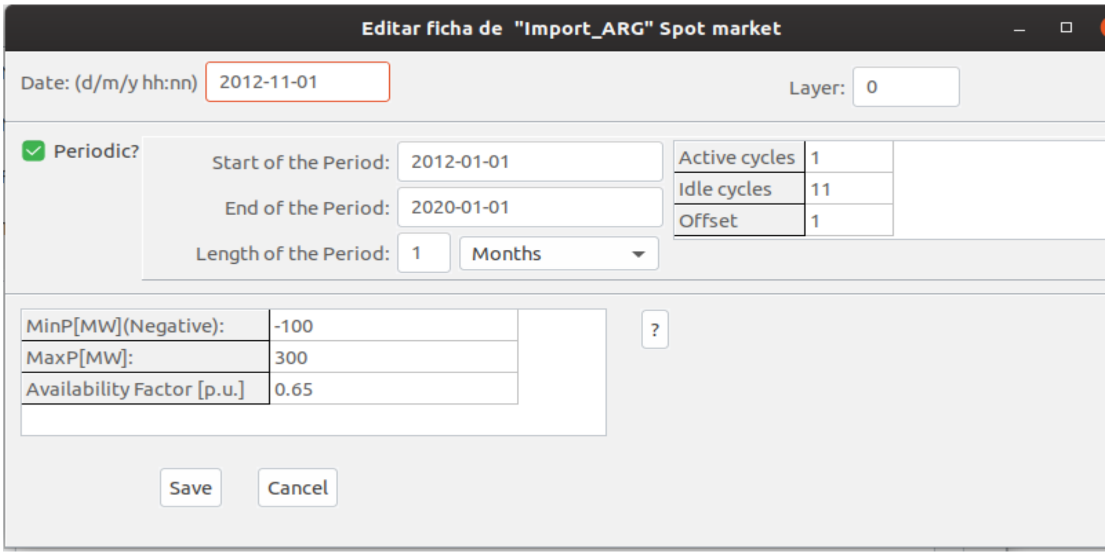


Fig. 9: Example of use of dynamic parameters.

In the example, it is an import modeled as an Actor of the “Market Spot” type. To represent that the energy availability of the selling country can vary substantially depending on the season of the year due to parameters such as the rainfall regime and temperature, variable interconnection availability factors with the seasons of the year are considered. And this is repeated in the same way every year. Thus, two periodic records can be defined for the Actor, one, whose validity begins in May and the other, whose validity begins in November, as shown in Fig.10 (Note that for these last two records the column “Periodic?” is marked with “YES”, unlike the previous cards that indicate “NO.” The first two cards are overwritten by the periodic ones).

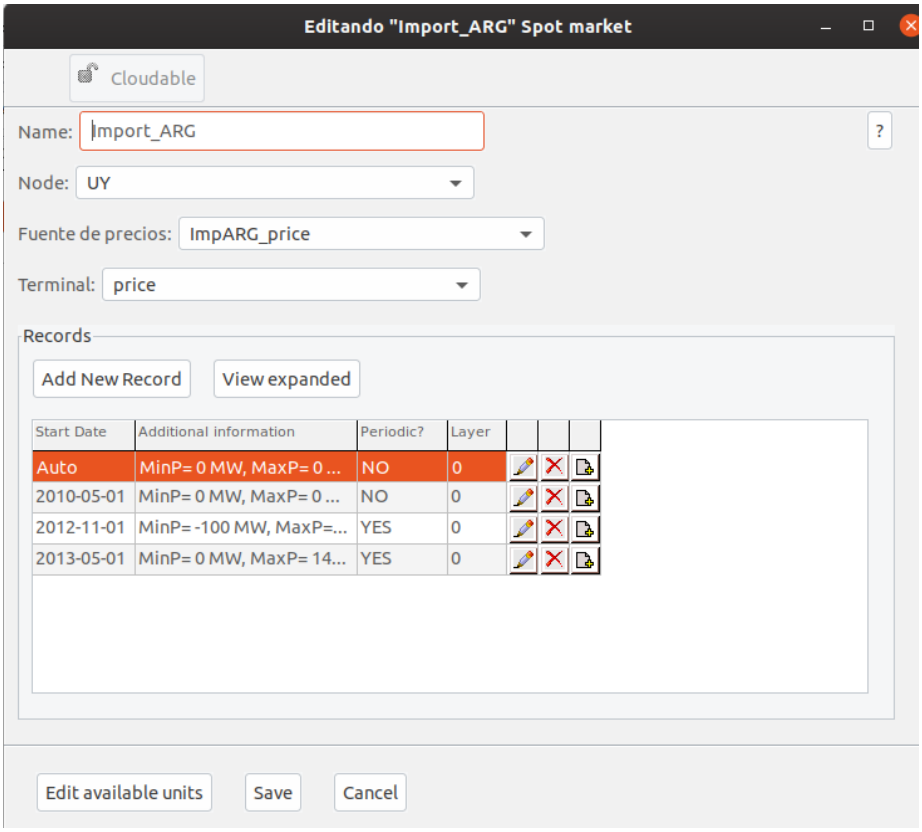


Fig. 10: Two periodic cards to give seasonality.

The file corresponding to the summer (in the southern hemisphere) period is shown in Fig.9, and there it can be seen that, although the periodicity is annual, it was declared in months, in order to allow the beginning of summer to be displaced by one month. The record is activated for one cycle (one month) and is not activated again during the following 11 cycles (but remains active until another record overwrites it). This will be the case for all the months included in the 2012-2020 interval during which it is declared that the periodicity is in force, beginning on 1/11/2012 (start date of the "summer" record). If the displacement were null, the record would begin to be valid from November, every year. But a displacement of 1 month was indicated, this means that it will begin to be valid from December every year. When May arrives, the other complementary "winter" card will begin to be valid, which, as seen in Fig.11, modifies the Power and availability of said import.

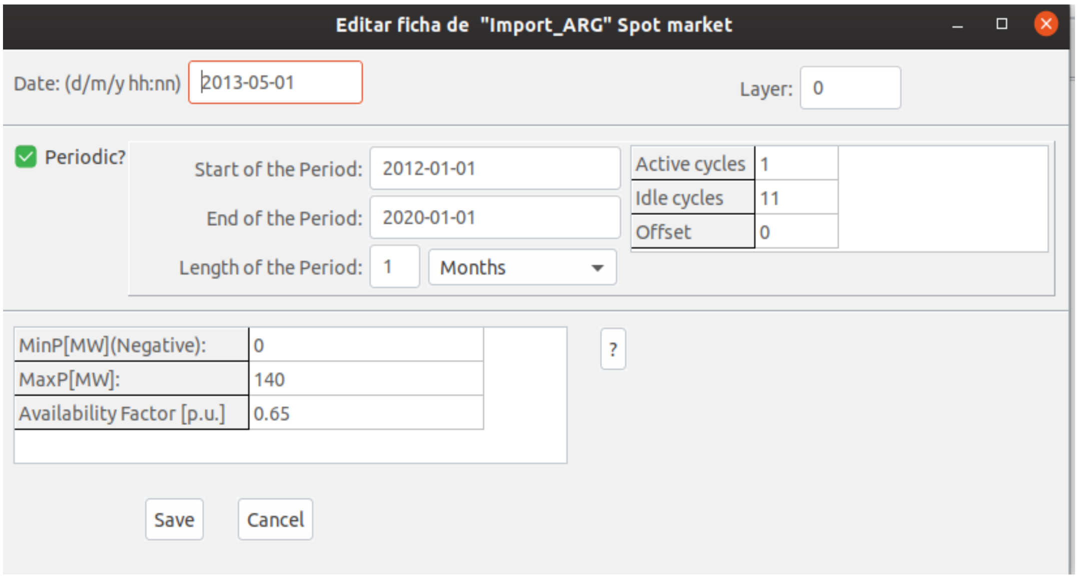


Fig. 11: Winter start record for the example.

In the example, the analysis horizon is from 27/4/2013 to 1/1/2020 and the simulation time step is weekly. The two record trains generated by both periodic records and the respective horizon and cadence filters are shown in Fig.13. As can be seen in this example, the "horizon filter" of the records is wider than the analysis horizon, so that the effective records are limited by the analysis horizon.

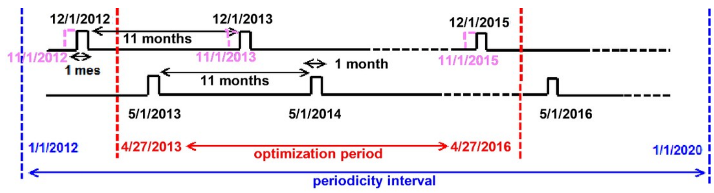


Fig. 13: Scheme of record trains generated in the example.

Fig. 12: Deployment of the records expanded by all the records of an actor.

You can check how the periodicity was set using the "View Expanded" button, provided by the Actor's editor. In Fig.12, you can see the "View Expanded" button and in an overlay window, the result of having pressed the button with the list of the records that will be effective according to the definitions given.

3.1.c.iii Example 3.

As an example, suppose a plant composed of 2 generating units with the same characteristics and that as of January 1, 2013, every year, in April one of the units must be taken out of service for 30 days to carry out preventive maintenance tasks.

To model this maintenance routine, you must create a first non-periodic record with starting date on 01/01/2013 with 2 units available and none in maintenance.

Subsequently, the periodic maintenance routines must be entered, for which 2 periodic records must be created. One of them must be activated every month on April 1 and leaves one of the units out of service. The other record must be activated every May 1, returning the maintenance unit.

In Fig.14 the “Available Units Editor” is shown with the corresponding records.

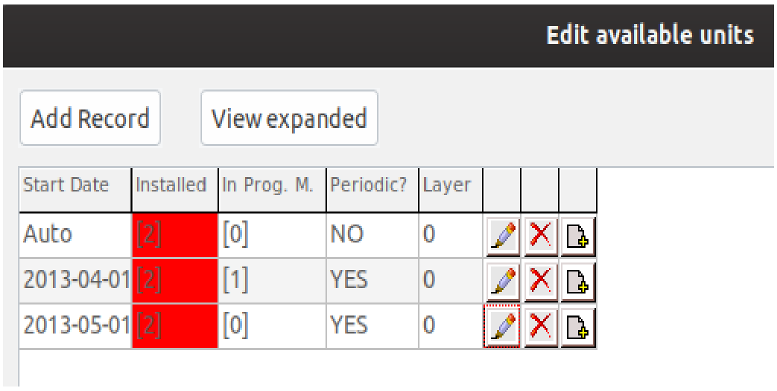


Fig. 14: Unit records of Example 3.

In the first file (Fig.16), it was specified that the beginning of a period is the month of April of the year 2013, that the Length of the Period is 1 year, Cycles Active 1, Inactive 0 and Displacement 0.

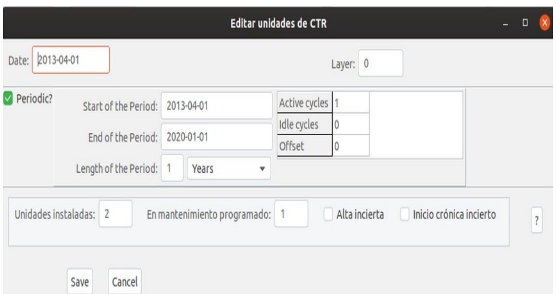


Fig. 16: First periodic record.

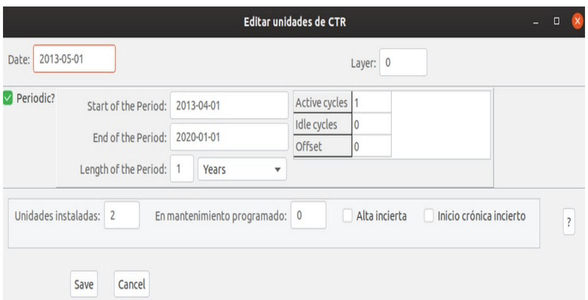


Fig. 15: Second periodic record.

In the second record (Fig.17), it was indicated that the start date of the period is May 1 2013, the length of the period 1 year and the number of active cycles 1.

In this way the maintenance routine was created throughout the period of interest.

With the *Expanded View* button, you can view all the records (Fig.17). It is clearly observed that every year in April one of the machines goes out of service (indicated with M: 1 which means a unit in maintenance) and in the month of May the 2 machines are available (indicated with M: 0 which means that no machine is in maintenance). In the table in Fig.17 the nomenclature (I: 2 M: 1) means that there are two machines installed (I: 2) and one in maintenance (M: 1).

Start Date	Additional information
Auto	0, Auto, I:2 M:0
2013-04-01	0, 2013-04-01, I:2 M:1
2013-05-01	0, 2013-05-01, I:2 M:0
2014-04-01	0, 2014-04-01, I:2 M:1
2014-05-01	0, 2014-05-01, I:2 M:0
2015-04-01	0, 2015-04-01, I:2 M:1
2015-05-01	0, 2015-05-01, I:2 M:0
2016-04-01	0, 2016-04-01, I:2 M:1
2016-05-01	0, 2016-05-01, I:2 M:0
2017-04-01	0, 2017-04-01, I:2 M:1
2017-05-01	0, 2017-05-01, I:2 M:0
2018-04-01	0, 2018-04-01, I:2 M:1
2018-05-01	0, 2018-05-01, I:2 M:0
2019-04-01	0, 2019-04-01, I:2 M:1
2019-05-01	0, 2019-05-01, I:2 M:0

Fig. 17: Expanded records

3.2. Main Menu of the SimSEE Editor.

The “SimSEEEdit” program is the Room Editor for SimSEE. The initial screen of the Editor is shown in Fig. .18.

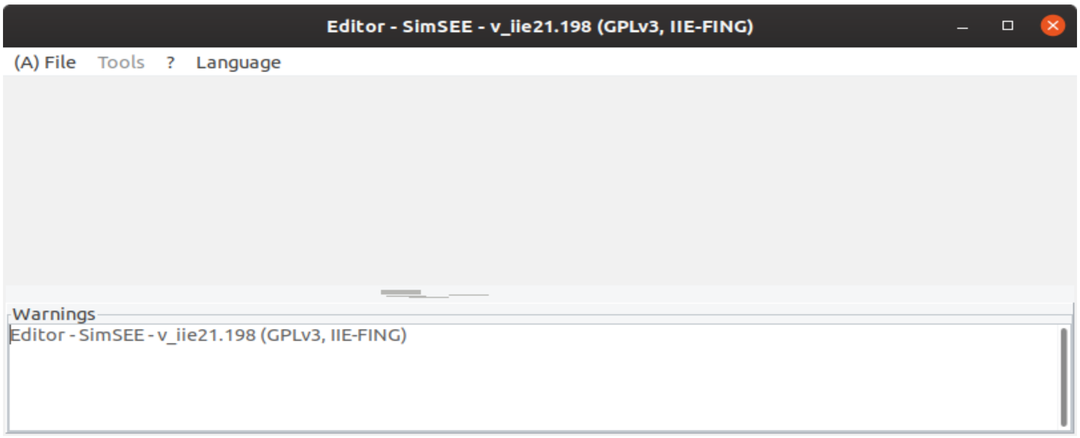


Fig. 18: Pantalla inicial del Editor.

ations that the user considers useful, in order to document your simulation.

In the lower part, a **“Warnings”** window is displayed where warnings about possible errors are displayed, if they occur. For example, when you change the version of SimSEE, when you open a Room made with some previous version, warning messages may appear indicating the changes made by the version change.

The different options presented in the SimSEE **Main Menu** are described below.

3.2.a) Opción "Archivo"

By clicking on the **"File"** option of the Main Menu, a sub-menu will open as shown in Fig.19.

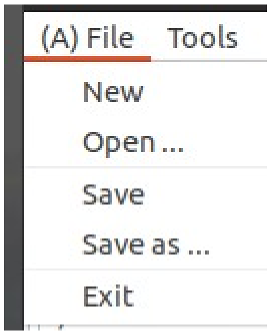


Fig. 19: Menu->File.

The possible actions from the **File** sub-menu are the following:

- **"New"**: allows you to create a new *Room* file, empty without Actors.
- **"Open…":** to select and open a previously saved *Room* file.
- **"Save"**: to save the *Room* being edited to disk.
- **"Save As…"**: to save the *Room* that is being edited under another name.
- **"Exit"**: to exit the SimSEE Editor.

Once an existing Room file has been opened, or the creation of a new empty Room has started, a screen will open with a series of flaps, as shown in Fig.20, which allow editing the different components of the PlayRoom .

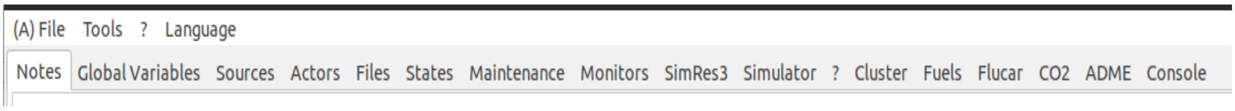


Fig. 20: Main tabs of the Editor.

The use of each tab in Fig.20 is described later in section 3.3.

3.2.b) "Tools" Option.

The **"Tools"** option is only enabled once a Room is opened. Clicking on the **"Tools"** option will open a sub-menu as shown in Fig.21.

This sub-menu allows you to select the action to be performed according to the detail of the following subsections.

Fig. 21: Tools Sub menu.

3.2.b.i Import an Actor.

It allows to import into the Room an Actor (file with extension ".act") previously saved with the option "Export Actors" from the SimSEE libraries folder (by default in {$HOME}/SimSEE/librerias/). This same action can be performed from the Actors edit screen ("Actors" tab).

3.2.b.ii Export Actors.

Allows you to select one or more *Actors* to be exported to the SimSEE *libraries* folder. This same action can be performed from the *Actors* edit screen ("Actors" tab).

3.2.b.iii Generate Thermal Summary.

It generates an Excel spreadsheet with a list of the relevant information for the Actors corresponding to the Thermal Generating Plants present in the simulation: Minimum power (if specified) and maximum (MW) of each unit, variable cost at minimum power (if specified) and average cost (according to its dispatch in the simulation) in USD / MWh, incremental variable cost of generating the next MWh, availability factor specified for each unit (pu), start and stop cost (USD) (if specified), etc., as shown in Fig.22. This is a summary of its initial parameters, not taking into account the evolution of the Generators given by the dynamic parameter tabs.

The summary is automatically saved in the folder {$HOME}/SimSEE/rundir/room_name.

Name	MinP[MW]:	MaxP[MW]:	MinP_VC[USD/MWh]	Medium_VC[USD/MWh]	Incremanta_VC[USD/MWh]	AvailF[p.u.]	Start-up Cost [USD]	Stop-down Cost [USD]	N Units	Min. NOn-Steps
APR	-	22.7	-	122.8	122.8	0.9	-	-	-	-
BIO	-	10	-	0.01	0.01	0.85	-	-	-	-
CC180	-	180	-	187.8	187.8	0.85	-	-	-	-
CC540	-	180	-	187.8	187.8	0.85	-	-	-	-
CTR	-	111	-	147.4	147.4	0.7	-	-	-	-
FO_MOT	-	10	-	80	80	0.8	-	-	-	-
PTI	-	48	-	115.9	115.9	0.85	-	-	-	-
TG60	-	60	-	104	104	0.85	-	-	-	-
UPM2	-	0	-	0.01	0.01	0.9	-	-	-	-

Fig. 22: Summary of thermal generators.

3.2.b.iv "Packing".

Create a compressed file (*.zip*) in the sub-folder in which the Room file is located and with the same name of the room, containing the room (*.ese* file) and all the files referred to by the Room. This allows the room to be transported to another computer.

3.2.c) Option "?" (Help).

The **"?"** option attempts to open the default web browser of your computer with the online help for the use of SimSEE. For help to be deployed, you must have a browser configured and access to the Internet. In different parts of the Editor, where the "?" Question symbol appears when pressed, the help page is displayed according to the context in which the button appears. The online help is permanently improved thanks to user feedback, so if you have suggestions on how to improve an explanation, do not hesitate to use the contact form at: https://simsee.org/contacto_en.php to make your contribution.

3.2.d) Option "Language".

This option allows you to change the Language used in the SimSEE platform. For now, the available languages are Spanish (default language) and English. When using this option, a window will open with a message indicating that the language change will be effective as of the next time you open the application.

3.3. Main tabs.

When creating a new Room or when opening an existing one, a Room is displayed in the Room Editor like the one shown in Fig.23 (indicated by the red arrow).

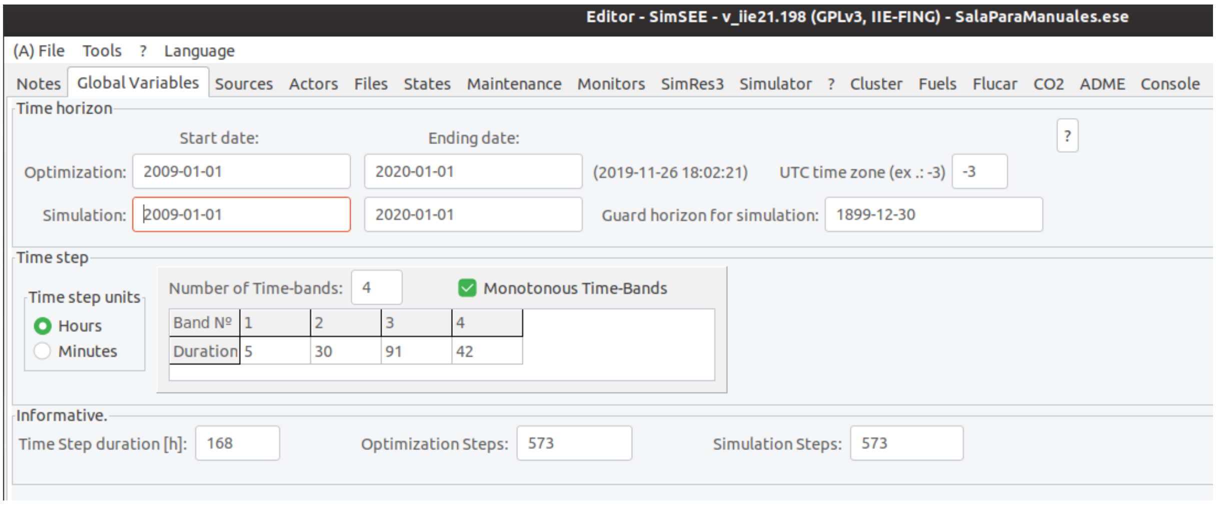


Fig. 23: Main Tabs of the SimSEE Room Editor

The use of all these flaps is described in the following sections.

3.3.a) Notes Tab.

This tab is where SimSEE opens by default. It allows you to edit an extensive text field in which it is convenient for you to add all the relevant information about the Room. For example a description of the purpose and of the most important assumptions made. This information is stored in the Room itself and is very useful for potential future users and for yourself as a Memory Aid.

3.3.b) Global Variables Tab

In the "Global Variables" tab you define the global parameters of the Optimization/Simulation. Data entry is as shown in Fig.23. The **Start and End Dates** allow defining both the time horizon of the **Optimization** and the **Simulation**.

The Simulation horizon must always be contained in the Optimization horizon, since it is during the Optimization process that the optimal Operation Policy of the system resources will be determined; policy that will be necessary to carry out the Simulation.

It is advisable to leave a margin at the end of the Optimization horizon (that is, that it exceeds the Simulation horizon) so that the values of the Future Cost function (which are built from the future to the present, in the recursion of the Stochastic Dynamic Programming algorithm) have been stabilized in representative values independent of the initial condition of the algorithm. This margin is called "optimization guard horizon".

How extensive the "guard horizon" should be depends on the system under simulation, and in particular, on the time constants involved. Another factor that affects the stabilization of the Future Cost function is the discount rate used (parameter specified in the Simulator tab sec. 3.3.i)). We recommend using rates higher than 8% per year.

The **"Start Date"** is the start date of the first time step.

The "End Date" is the start date of the step following the last time step considered by the simulation.

Strictly, if the start date is called t_{ini} , the end date t_{fin} and Δt the duration of the time step, lthe time steps will be identified by the ordinal $k=1,2...N$ with the greater N such that $(t_{ini}+(N-1)*\Delta t)<t_{fin}$.

The **"Sim Guard Date"** allows you to specify a date from which the simulation results are written. This allows you to easily ignore the start of a simulation as a way to become independent of the initial condition of the system during the simulation. The value "1899-12-30" shown in the example in Fig.23, being before the start date of the simulation ("2009-01-01" in the example), implies that all will be saved the results from the beginning of the simulation.

In the "Time step" panel, the option to select the "Time step units" is presented.

In Fig.23 the "Time Step" panel is shown when "Hours" units have been selected. In that condition, you must specify the number of Bands (or time bands) into which the time step will be divided (4 in the example in Fig. .23) and in the Band duration table specify the duration in hours of each of the bands.

Fig. 24: Panel of the passage of time in Minutes.

If instead of marking "Hours" as units, "Minutes" is marked, the Panel changes to the format of Fig.24. As you can see, if "Minutes" is selected as a unit to specify the time step, then it is not allowed to sub-divide the Step into Bands and only the duration of the step in minutes is allowed to be specified. The possibility of running simulations with the passage of time in minutes is more for academic and research purposes than for the actual operation of the electric power generation system.

In the "Informational" panel, the duration resulting from the Time step (sum of the hours of the Bands) and the number of steps in which the Optimization and Simulation horizon will be divided are displayed.

Returning to the example in Fig.23, with the units selected in "hours", the "Monotone Bands" box indicates whether in the partition of the time step in posts, the hours of the passage are messed up or not. The most common use is with the box marked and implies that the hours of the passage of time will be ordered according to the Monotone Load curve. The Monotone of Load is constructed by ordering the hourly power of the Demand (from the first of the Demand Actors if there is more than one) in decreasing form, thus creating a new order of the hours in the passage of time. In this way, a new order is created in the hours of the passage of time. In the new order, the first hours are those of Band 1 (hours of higher demand), the second hours of Band 2 and so on until reaching the last Band (hours of lower demand). If the box is unchecked, the hours of the passage are not messed up and then, Band 1 will contain the first hours of the passage (in the natural chronological order), the second the following ones and so on until completing the time step with the last Band. Unmarked use is for academic purposes, so always check that the "Monotone Posts" box is checked (unless you are doing some analysis in which it makes sense not to mark it).

If you do not want to use the subdivision mechanism of the Time Lapse in Bands, just indicate that the number of bands is 1 (one) and make that single band have the duration in hours that the Time Pass should have.

3.3.c) “Sources” Tab.

In the Sources tab, it is possible to add and edit the Sources in the PlayRoom. A Source is a generator of values that can be used by the Actors and other Sources. An example (for a given Room) of the contents of the tab is shown in Fig.25

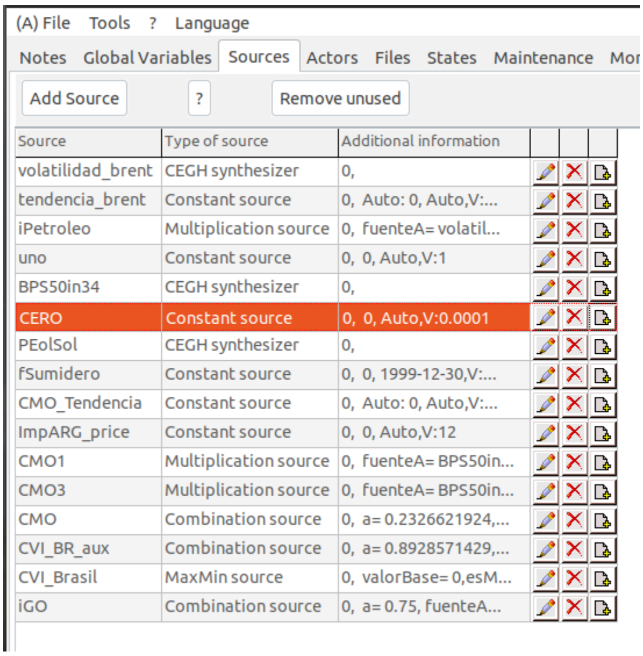


Fig. 25: Example of the contents of the Sources tab.

Pressing the “Add Source” button displays the form in Fig.26 that allows you to select the type of source to add. The different source models are detailed in VOLUME 2 of this same series of manuals.

Once selected and configured, the source is added to the list of sources shown below the "Add Source" button.

Pressing the "Delete unused" button removes all sources that are not being referenced by any other entity from the Room.

To "edit" the parameters of a source, press the pencil in the list, to remove the cross and to "clone" (make a twin copy) the button .

If you try to delete a Source that is referenced by an Actor or another Source, you will receive an error message. You must go to the entity that refers to the source and delete the reference in order to remove the Source.

Fig. 26: Add Source selector form

A common use of sources is to model price growth rates to affect, for example, the generation costs of Actors who consume the same type of fuel. Another common use is the modeling of resources that are inherently stochastic such as the flow of contributions to hydroelectric power plants or wind speed in wind generation parks.

As an example of use in an Actor, a dynamic parameter record corresponding to a thermal power plant can be seen in Fig.27, in which a variable cost of 224 USD/MWh is considered, and that in the same form, the source "iGO" and its "fuel" terminal to has been selected as "Fuel Price Index".

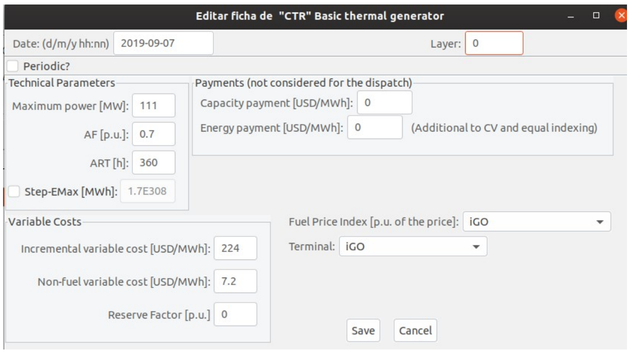


Fig. 27: Actor example using a Source.

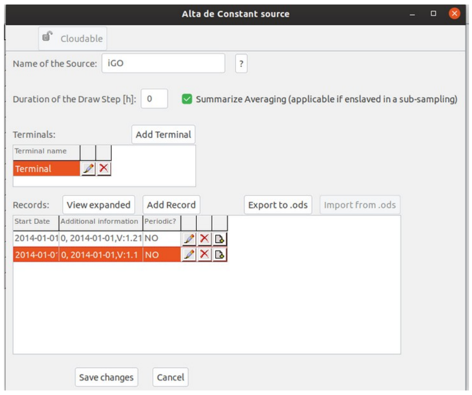


Fig. 28: Example of Constant Source.

In Fig. 23 the parameters of the "iGO" Source are shown and as can be seen, it has two dynamic parameter tabs. The first one sets the value 1.1 upon its departure as of 01/01/2014 and the second one sets the value 1.2 as of 01/01/2015. In short, this index will be defined as of January 1, 2014 at 1.1, which will imply that the variable cost for the dispatch of the plant will be 224 * 1.1 = 246.4 USD/MWh and will have another increase as of January 1, 2015 in which it will have a variable generation cost of 224 * 1.21 = 271.04 USD / MWh.

3.3.c.i Sources and terminals.

The Sources make available, in their Terminals (or outputs), different values in order to be used by the Actors or other Sources within the same Room. To make use of a source, in a Entity (Actor or Source), the Source and the Source Terminal to which the Entity will be connected must be selected.

Most sources make a single terminal available, but there are some that offer several terminals. The typical example of a multi-terminal source is those created of the "CEGH Synthesizer" type, representing a multi-variable stochastic process. In these cases, given the correlation between the series, it is not possible to model them as independent sources, and a single source, with multiple terminals, has to model the set of variables whose joint process is to be modeled.

A Source consists of Static Parameters (those that do not vary over time) and Dynamic Parameters (those that can be specified with time variation). Fig.29 shows the typical form of static parameters of a Source including the list of records with definition of dynamic parameters.

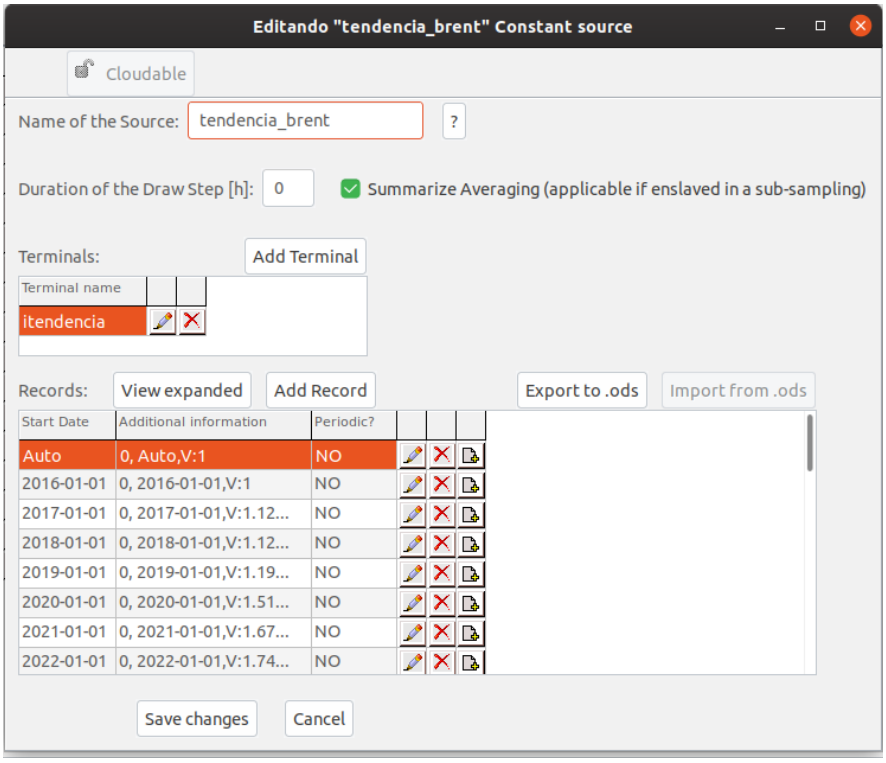


Fig. 29: Form with the common static parameters of the sources.

The static parameters common to all sources are the "Name", the "Duration of the Draw Step [h]", the "Summarize averaging (if enslaved in a sub-sampling)" box and the list of "Terminals".

The **Name** is the identifier of the source (as an entity in the Room). This identifier will be the one that appears in the selection listings in the fields of the forms in which it is possible to select a source.

The **"Duration of the Draw Step [h]"** allows you to specify the duration of the draw step (in hours) for the source. This duration of the draw step is the "natural" of the source, understood as such, that rate of generation of values for which the source was designed. As an example, if a source is constructed to generate values that represent the average weekly values of flows of water inflows to a hydroelectric plant, the natural rate of that source will be weekly. If that source is used in a Room with monthly time step, it would be imposing a fixed value throughout the month with the variance of weekly values, which does not represent reality. Likewise, if the source were used in a Room with 1 hour time step, it would be generating an hourly value with the weekly variance that is not correct either. To allow the use of sources with a natural cadence different from the time step of the Room, the parameter "Duration of the Draw Step" is used. If a value of 0 (Zero) is entered, it is indicated that the source does not have a preferred natural cadence and that it is used as if its natural cadence coincides with the time step of the Room. If a value other than Zero is specified, then the behavior is as follows:

a) If the Duration of the Draw Step is greater than the duration of the Room Time Step (for example a weekly source in an hourly Room), the source will be "enslaved" in an "over-sampling" mechanism. This mechanism is transparent to

the user. At runtime, another source is created that supplants the original and "enslaves" it. The new source generates values in accordance with the Room Time Step, for which it asks for values from the enslaved source with the cadence corresponding to the "Duration of the Draw Step" and interpolates between the values obtained to generate the values available in its terminals .
b) If the Duration of the Draw Step is shorter than the duration of the Room Time Step (for example an hourly source in a weekly step Room), the source will be enslaved in a "sub-sampling" mechanism. This mechanism is transparent to the user. At runtime, another source is created that supplants the original and "enslaves" it. The new source generates values according to the time step of the Room for which it asks for values from the enslaved source with the cadence corresponding to the "Duration of the Draw Step" and summarizes the set of values received in a value for each time step of the Room. This summary can be done in two ways and for this the **"Summarize averaging (applicable if enslaved in a subsampling)"** checkbox is used. If the box is checked, the sample sets received from the slave source are summarized by a simple average. If the box is not checked, the set of values is summarized by choosing any of them randomly with equal probability. Note that both ways of summarizing end up giving the same expected value as a result, the big difference is in the variance of the values produced. The average method considerably reduces the variance. The random method gives maximum variance.

This alternative was developed to estimate the error made in weekly time step Rooms (Typically long-term rooms for investment analysis) when considering hourly sources of wind power generation.In the case of wind power, in a system with hydroelectric plants, the reservoirs act as a filter of variations, reducing the effects of the variance of the resource. As the amount of wind MW in the system increases, that filter will not be able to absorb all the variations. Executing the same Room with "summarize averaging" marked and unmarked, an estimate of the error made when assuming the average is obtained.

In addition to the static parameters, the Sources have **Dynamic Parameters**. Each type of source has a specific set of parameters according to its model.

The set of sources available in version viie21.198 of SimSEE is as follows is the shown in Fig.26.

In the "Source Reference Manual - SimSEE", Volume 2 of this series of manuals, the model and configuration parameters for each type of source are detailed.

3.3.d) <u>Actors Tab</u>

Electric power systems are composed of different Actors (entities), which can deliver energy to de system or consume energy from the system. For example, generation plants deliver energy to the system, international interconnections can deliver or consume energy and demands are energy consumption.

In addition, there are specific actors that allow the modeling of the electrical interconnection network with its energy losses and physical transport limits. These actors are **Nodes** (to which the other Actors connect) and **Arcs** (energy transport corridors that link the Nodes).

If the Actors tab is selected in the Editor, the different tabs of the groups of actors that can be created and the "?" tab where help on the "Actors" tab is available are enabled. These tabs can be seen in Fig.30.

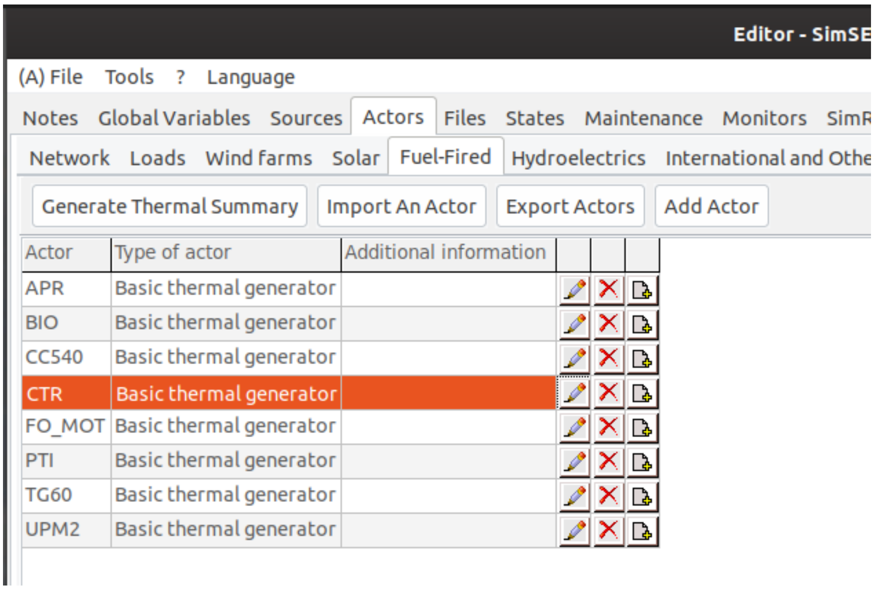


Fig. 30: Example of the contents of the Actors tab.

Actors that can be created in SimSEE are classified into the groups shown if Fig.31.

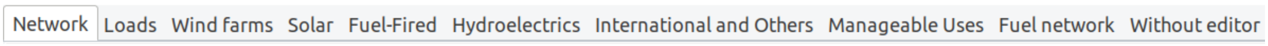


Fig. 31: Classification of Actors

The **Import An Actor** and **Export Actors** buttons allow you to import previously exported Actors or export Actors. They are the same actions accessible from the Main Menu and described in sec. 3.2.b). The **Add Actor** button allows you to add a new Actor by selecting from those available in the active tab as described later in this section.

Below the buttons in Fig.30 a table is displayed with the list of the Actors defined in the Room that belong to the group of the active tab ("Fuel-fired" in the example of 30). The buttons on the right side of each line of the list allow "Edit" the actor (the pencil ), delete it (the cross ) and clone it (the button ).

The **Add Actor** button allows you to add a new Actor in the Room. You must select the tab corresponding to the type of Actor you want to add and press the Add Actor button. For example, if you want to add a thermal generator, you must first select the Fuel-fired tab and then the Add Actor button.

Pressing the Add Actor button will open a selection form for the specific type of Actor that will be created among those available in the active tab. The content of the list of that form depends on which of the Actors tabs (Network, Demands, Wind, Fuel-fired, Hydroelectrics, International and Other, Manageable Uses or Without Editor) is active. The selection form that is displayed in the case of the "Fuel-fired" tab inside the Actors tab is active, is shown in Fig.32.

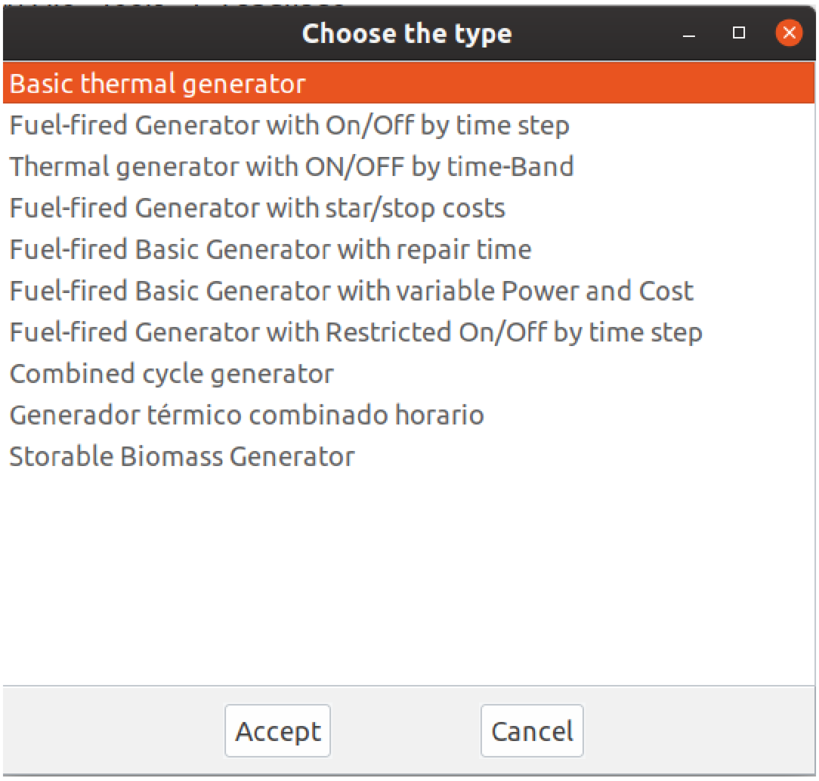


Fig. 32: Example of Actor type selector

As you can see, there are different models (or types) of Thermal Power Plants. Once you have selected the type of Actor you want to add, press the OK button. A new form specific to the type of Actor selected will be opened.

As an example, the Create/Edit form of a Basic Thermal Generator is shown in Fig.33. As you can see, you must specify a "Generator Name". In this case, because it is a generator, you must select the Node to which it will be connected. The "CO2 emissions" panel is also specific to the generators and allows specifying the tons of CO2 per MWh generated, if the generator is of the "Low Cost Must Run" type and if it participates in a Clean Development Mechanism type program.

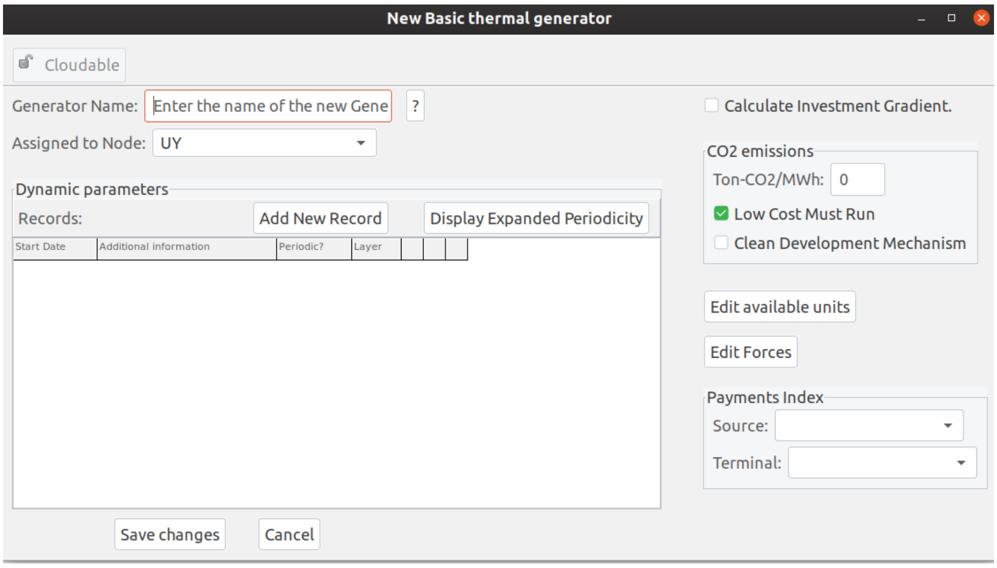


Fig. 33: Example of creating / editing a simple Actor form.

Next, you can see the pale with the list of Dynamic Parameters Records. The “See Expanded Periodicity” button shows in a separate window the set of records including the non-explicit records that are generated by the effect of the periodicities that have the explicitly defined in the records. The "Add New Record" button creates a new record and opens the form for editing it. The fields of the dynamic parameters record are specific to each type of Actor and are described in detail in Volume 3 "SimSEE Volume 3 - Actors" from this same series of user manuals.

Fig.34 shows an example of the form for editing the dynamic parameters record. In this case, it is a Basic Thermal Generating Actor. In general, as in any dynamic parameter record, the date from which it is valid, the Layer and the periodicity information must be specified (see sec. 3.1.c)“). The rest of the parameters are specific to the type of Actor used as an example and are described for each Actor in Volume 3 as already mentioned.

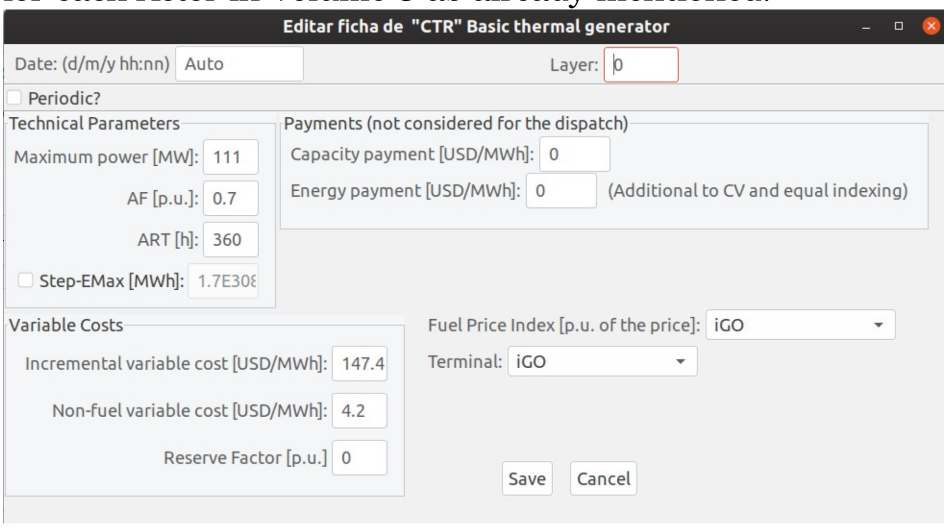


Fig. 34: Example of the dynamic parameters record of an actor.

In Fig.33, on the right side, the “Edit Available Units” and “Forces” buttons appear, which are common to all Actors.

The "Edit Available Units" button allows you to indicate how many identical available units (machines) the Actor has. There are actors such as Combined Cycles that have more than one type of unit (Gas and Steam Turbines) and in that case you have to specify how many units of each type are available.

The “Forces” button allows you to specify forced dispatch for generators, that is to impose a power delivery even if the economic optimum indicates another operation. An example of these situations is when a generator must go into operation to perform a test regardless of whether or not it is dispatched at that time by the normal operation of the system.

3.3.d.i Edit Available Units.

Once the actor is created, the number of Units available during the study period must be specified. For this, the **Edit Available Units** button is available. Pressing that button opens a form like the one in Fig.35. As you can see in this example, a list is shown that has a summary of the available units in each line. The summary indicates the date, the number of machines, whether the record is of the periodic type or not and the layer to which the record belongs.

The “Add Record” button is used to add a new record to the list and the buttons , and , to the right at each row are used to Edit, Delete or Clone the item associated with that row.

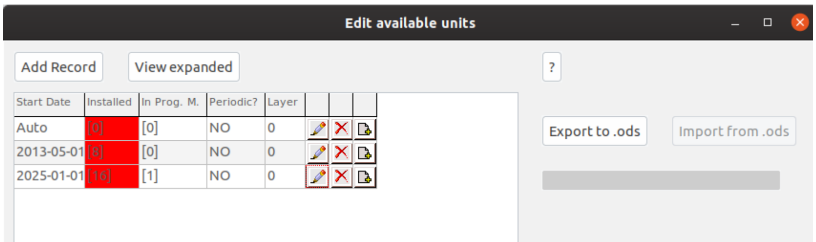


Fig. 35: List of available unit records of an Actor.

In the example, the Actor has 0 (zero) units from the origin of the times until 2013-05-01 in which it happens to have 8 units. It continues with 8 units until 2025-01-01 when it happens to have 16 units. The example corresponds to an expansion of the generation system and in this case each unit represents a 12 MW biomass plant. In this example, all the records belong to Layer 0 and are not periodic.

Pressing the “Add Record” button or the pencil of one of the existing records opens the editing form like the one in Fig.36. In this form you can see the parameters "Date", "Installed units", “Units in schedule maintenance” "Layer" and "Periodic?". In the case of marking the periodicity box, the corresponding panel is enabled with the parameters that define the periodicity.

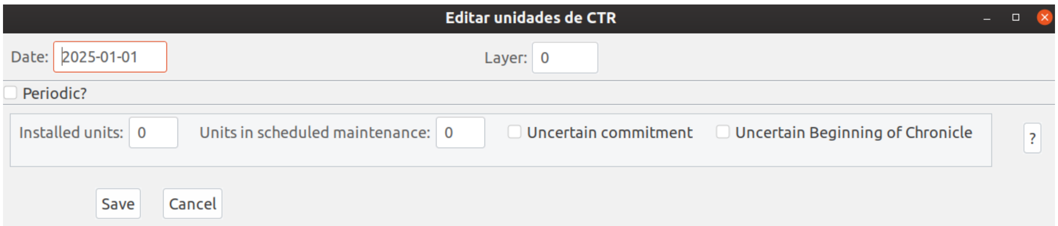


Fig. 36: Single generator units record

Returning to Fig.35, the "Export .ods" and "Import .ods" buttons allow you to export to a LibreCalc spreadsheet the set of available unit records to facilitate your joint modification and then import again. The export is done by writing to the hard disk of your PC a temporary file with extension .ods and open it to allow editing. The import works by reading the same file, so it is necessary that you SAVE the modifications you make to the file before pressing the "Import .ods" button.

As can be seen in Fig.36 in addition to the aforementioned parameters, there are the "Uncertain commitment" and "Uncertain Beginning of Chronicle", options that are explained in the following sections.

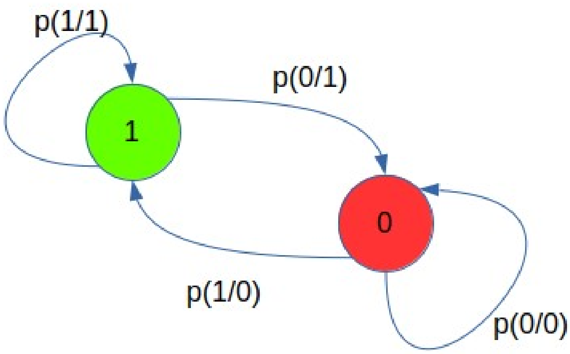


Fig. 37: Failure-Repair Model of the Units.

3.3.d.ii Failure – Repair Model.

Internally, SimSEE creates a Fail-Repair model to manage the availability of the units of any entity. Between the parameters of the entity (generally between the dynamic parameters) the parameters Availability Factor (AF) and Average Repair Time (ART) can be specified.

The model implies the recognition of two possible states of the units: Available (1) and Unavailable (0) as shown in Fig.37 and the definition of transition probabilities between these states. The AF represents the probability that the unit is available if we observe it without knowledge of its previous state. For example, an AF = 0.9 will indicate that if we observe the unit, without knowledge of the previous state, with a 90% probability it will be in the Available state and with a 10% probability in Unavailable state. The Average Repair Time (in hours) represents the expected value of the time that once the unit enters the Unavailable state, it remains in that state. Based on the AF and ART parameters and the Room's time-step , SimSEE calculates the transition probabilities between the applicable states during the simulation.

3.3.d.iii Uncertain commitment.

If the "Uncertain commitment" option is selected, when units (that can be new units or units that were in scheduled maintenance period) are entered, they are added to the Unavailable unit set. This means that they will be really operational according to the probability of repair of the units defined in the dynamic parameters record of the Actor. Depending on the parameters Factor of Availability and Average Repair Time, the units may randomly enter in service immediately or not with a delay in the effective entry according to the specified Average Repair Time.

In the event that this option is not selected, the units will be available effectively on the established date.

As an example Fig.38 shows the results of a daily and 1000 chronicle simulation of a 100 MW average power generator with AF=0.7 y ART=360h.

At the beginning of the simulation the generator has an available unit (record with date "auto" indicating 1 (one) unit available) that goes out of service to perform a scheduled maintenance routine (2015-02-01 has a tab indicating 0 (zero) unit available). The unit is one month in scheduled maintenance and "returns" (a tab on 2015-03-01 indicating 1 unit available). The two curves in the figure correspond to the same room simulated with “Uncertain Incorporation” marked (Red curve) and unmarked (Blue curve) in the 2015-03-01 record. The curves correspond to the expected power in the set of the 1000 simulated chronicles. As can be seen, on the right side, both curves verify the value of the specified Availability Factor (0.7). The differences are at the time of commitment the unit. In the case of the blue curve (Uncertain commitment = FALSE) the machine enters for sure, and therefore has an expected power of 100% value that is decreasing towards the steady state probability. In the case of the red curve (Uncertain commitment = TRUE) the machine will be effectively operational randomly with the Failure/Repair model in an average time equal to the specified Average Repair Time. For that reason, the expected power starts from 0 (zero) and goes to the stable state value corresponding to the availability factor.

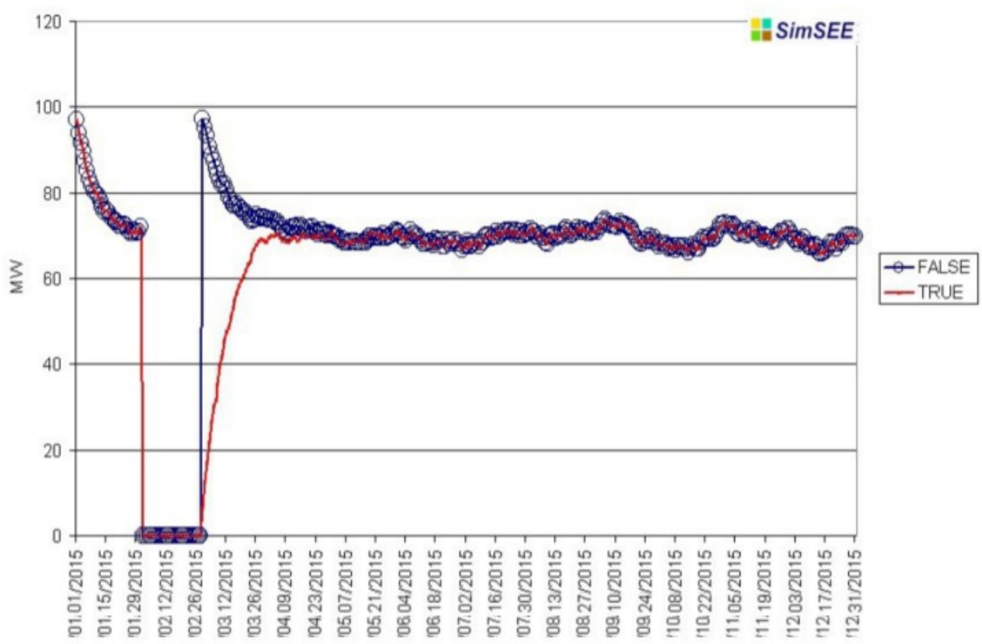


Fig. 38: Efectos del Alta Incierta sobre la Potencia Esperada.

3.3.d.iv Uncertain Beginning of Chronicle.

This option of the unit records (see Fig.36) allows you to specify the treatment of the availability of the generating units at the beginning of each simulated chronicle. Normally, this option is set to FALSE in the case of simulations of short-term rooms where the state of the machines can be well known and is set to TRUE for long-term studies in future horizons, where the initial state of the machines is unknown.

If the “Uncertain Beginning of Chronicle” box is checked, at the beginning of each simulation chronicle, instead of assuming that the units are actually available, raffles are held and will be available according to the Stationary Status Availability Factor (AF) that you have specified for that generator in the dynamic parameters record valid at the beginning of the simulation horizon.

The simulation result of 1000 chronicles of a room in which there are two identical simple thermal generators of 100 MW and a demand of 200 MW is shown in Fig.39. The generators have an availability factor AF = 0.7 and an Average Repair Time of ART = 360 hours. In the example, generators are dispatched whenever they are available, as they are the most economical resources in the simulation. The only difference is that in generator 1 (G1 in the figure) it "Uncertain Beginning of Chronicle" is unmarked (False), while in generator 2 (G2 in the figure) "Uncertain Beginning of Chronicle" is marked (True).

As you can see, at the beginning of the simulation (left side of the figure) the blue curve begins with an almost 100% dispatch and decays exponentially towards 70% corresponding to the steady state probability. The orange curve starts directly with an expected power of 70% corresponding to the steady state power given the availability factor of 0.7.

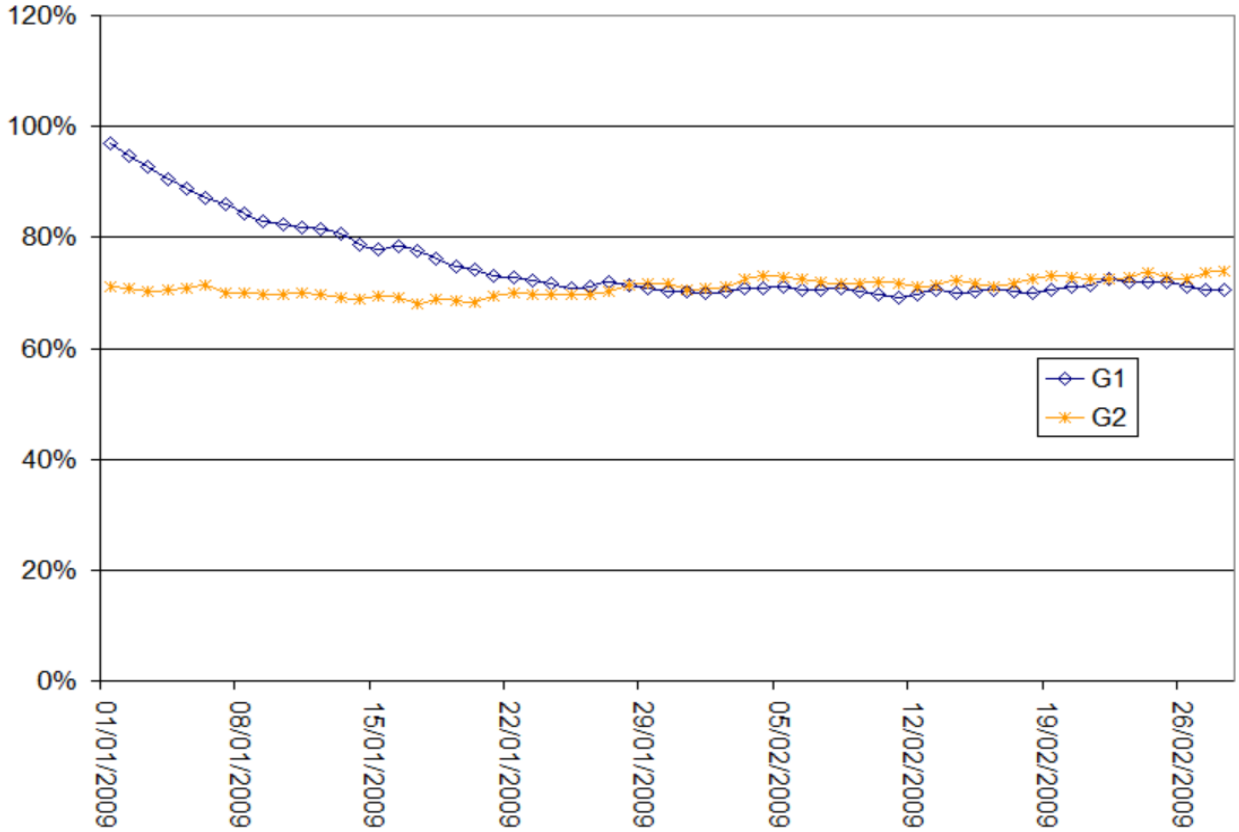


Fig. 39: Effect of the "Uncertain Chronicle Start" option on the available power.

The G1 curve (blue) does not start from 100% because what is known is that at the beginning of the first simulation step the unit was available, but a draw is made (in the fault/repair model) and with the probability of transition from the Available state to the Unavailable state (p(0/1) in Fig.37) the unit will not be available in the first simulation step.

3.3.e) Files Tab.

In the “Files” tab (see Fig.40) it is possible to manage external files, linked to the Room. With the “Add File” button it is possible to select a file from your computer to be linked to the Room. If the Room is “packaged” (see section 3.2.b.iv) all the files listed in this tab will be compressed in the same packaged Room and their references changed in such a way that when unpacking the room all the files remain in the Room directory.

In different parts of the Editor, when you need to reference a File, you must have previously added it to the list of files linked to the Room using the “Files” tab.

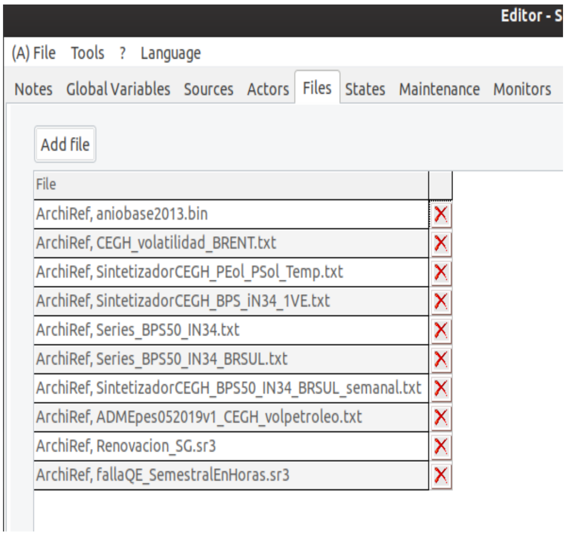


Fig. 40: Files Tab.

You can also add files that even if they are not referenced within the Room you may want to be linked to it and "travel" along with the packaged Room.

3.3.f) States Tab.

The States tab allows you to specify some characteristics that involve the **Cost of Future (CF)** function and the domain of that function, that is, the state of the system space.

The content of this tab is shown in Fig.41.

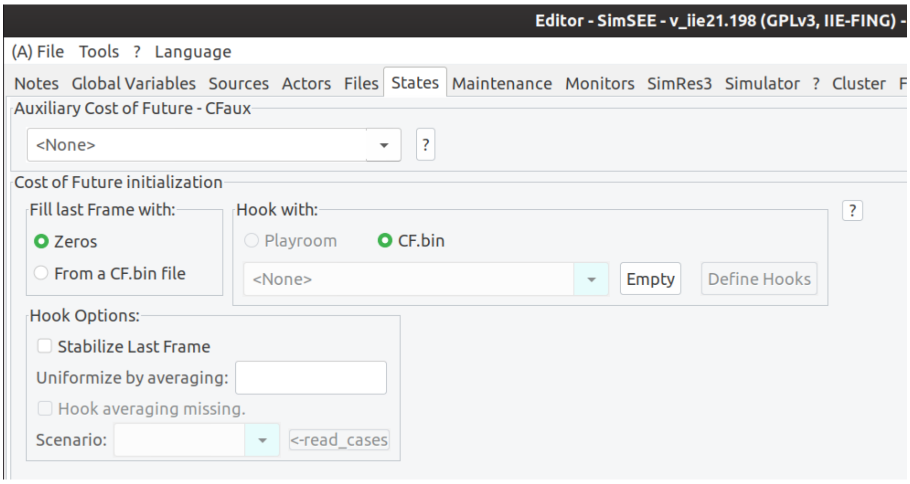


Fig. 41: States Tab.

In the upper panel **"Auxiliary Cost of Future-CFaux"** it is possible to define an auxiliary CF function (CFaux) for the Simulation. To be able to select the file you must previously add it to the set of files in the Room as explained in sec. 3.3.e).

The Cost of Future ($CF(X,k)$) represents the expected present value of the operation of the system with a given Operation Policy, starting from state X in time step k . The information that defines the Operation Policy (this is how the dispatch will be in each step of time) is contained in the CF function and that is why they are sometimes used as synonyms.

The functionality of defining a CFaux can be used during the simulation of the system in order to give an "auxiliary" evaluation of the Cost of Future of operation. While the simulation is always performed using the CF function obtained during the optimization to decide the optimal operation, the CFaux function can be used to analyze the evaluation of the Cost of Future that another Operator would make using a different operation policy (contained in CFaux). It is a way to compare two operating policies. It allows to analyze how the operation of the system would be seen by a different Operator, informing what is the value of $CFaux(X,k)$ for each state X through which the system is evolving (X represents the state of the system resulting from the simulation step by step). The CFaux value at (X, k) is exported as an available variable during the Simulation. (see Volume 4 SimRes3).

As an example, this functionality was used to compare a system operation policy that includes information on the surface temperature of the Pacific Ocean in the area known as N34 in the forecast of hydraulic contributions, with another that does not consider such information. For more details on this application example, see the work of Chaer R., Terra R., Diaz A., Zorrilla J., "Considering the information of the Niño 3.4 index in the operation of the Electrical System of Uruguay", 33° IAEE Rio de Janeiro 2010.
http://iie.fing.edu.uy/publicaciones/2010/CTDZ10/CTDZ10.pdf

The bottom panel **"Cost of Future Initialization"** allows you to specify the way in which we want to initialize the values of the CF function at the end of the last time step of the Optimization horizon. The stochastic dynamic optimization algorithm calculates the CF, back in time, from that initialization.
The options are:

- **"Zeros":** this implies zeroing the CF over the entire state space at the end of the last time step of the optimization horizon. It is the option that is used by default when the run is not going to be "hooked" with another one, that is, the future cost values are started to be calculated from scratch, and no initial values from another run are taken.
- **"From file CF.bin"**: this implies that the current Room "hooks" to another Room whose optimization has already been carried out. In this case you have to use the selector to select the file (binary format) of the longest simulation from which we want to initialize the current simulation. The chain of simulations is useful to be able to add detail to the modeling in the short term and to make optimizations in a reasonable calculation time.

The most common use of this option is to recover the information already calculated, by the longer-term Room, regarding the value of water from hydroelectric power plant reservoirs. For example, in the Uruguayan system, simulations involving horizons greater than one year are made using weekly time step and only the reservoir of the Rincón del Bonete dam is considered, as it is the only one with a reservoir capacity of some months. In this way, the water-value from the largest reservoir in the country is obtained. This type of Room is useful for planning purposes. For more short-term dispatch programming purposes, more detailed modeling is necessary, so Rooms are built that consider reservoirs whose reservoir capacity is about 2 weeks. These weekly deposits are not relevant when considering multiannual periods, but they are when analyzing the medium or short term.

The possibility of hooking Rooms allows to reduce calculation time without losing precision, allowing “successive refinements” according to the time horizon that you want to observe.

To make the hitch, SimSEE identifies the date of the end of the last step of the Room and the values are interpolated in the CF function to which the Room is attached. This resolves the temporary hitch, regardless of whether the time steps are different, it is enough only that **the end date of the last time step of the optimization horizon** of the current Room is comprised in **the optimization time horizon of the simulation** to the which we are hooking it.

It is also interpolated in the state variables, so it is not necessary that the discretizations of the different variables coincide in both simulations.

When two functions $CF(X,k)$ are engaged, it may be the case that the state spaces are different (in fact that is the case of the example mentioned above). It may happen that in the current simulation there are new state variables (volume of the reservoir added, in the mentioned example). In that case there is no information on the behavior of CF on that dimension of the state in the simulation to which we are hooking the current one, because in that simulation there was no such dimension of the state of the system. To initialize the CF in the first calculation table on the new dimensions that are added to the state space, what is done is to assume that the derivative of the CF with respect to that address is zero (this means assigning a null cost to the use of the variable of state).

Another case that can occur is that in the new simulation a state variable disappears from those that were defined in the simulation to which we get hooked. In that case you have to decide what value is set in the CF of the simulation to which we get hooked to that state variable. For this there is the **"Define Hooks"** button. By default, the hooks are defined with the midpoint of the intervals of the status variables, but using this button it is possible to change the value. An example of using this may be the consideration of the randomness of the price of oil. In long-term simulations it is not possible to consider the price of a barrel of oil as a constant, and it may be relevant then to consider it as a random source with status (CEGH model). But when going to the weekly simulation, with hourly step it does not make sense to keep it as a state variable and it can be assumed that its value is known: in this case you would have to use the "define hooks" button to set the price value of the barrel of oil at the value we estimate we can consider reasonable for the week considered.

The "Empty" button allows you to completely eliminate the hitch and return the default definition "Zeros".

The "Define Hooks" button allows you to access the Hook Editor shown in Fig.42. From what was described in the previous paragraphs, the hooking of Room A with the result of the optimization of Room B, implies defining values for the Future Cost function at the end of the Horizon of optimization of Room A from the information obtained from the future cost, the result of the optimization of room B, for the same temporary moment. If the vector X describes the state space of Room A and the vector Y describes the state space of Room B, the mapping that defines the hitch can be expressed as $Y=M(X)$ and the initialization as $CF_A(X, t_{final_{H_A}}) = CF_B(M(X), t_{final_{H_A}})$

PFor the definition of $Y=M(X)$, the form allows two options in the "Type of mapping" panel. If "Simple" is selected, it is worth what is shown in the "Simple Mapping" Panel in the left panel at the top. If " $Y=M(X)$ " is selected, it is worth what is shown in the right panel at the top.

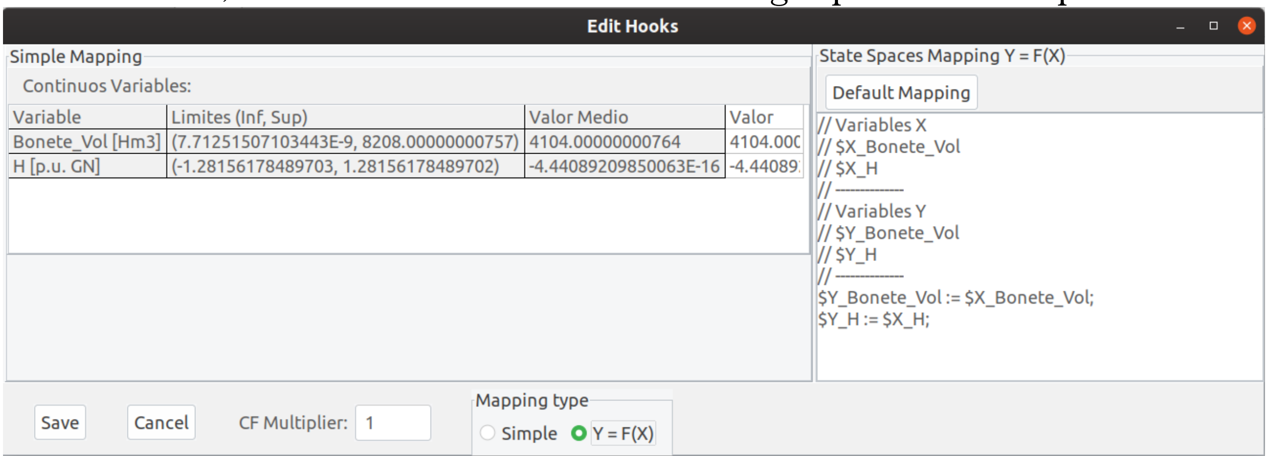


Fig. 42: Hooks editor.

In simple mapping, the variables that have the same name in both state spaces are assigned directly, the "new" variables that are present in X and not available in Y are ignored in the mapping (which implies imposing $\frac{\partial CF_A}{\partial x_k}=0$ for each new variable x_k) and "missing" variables, this is present in Y , but not available in X are set to a value that by default is half the range of the variable but can be specified using the "Simple Mapping" panel.

If "Mapping Y=F(X)" is selected, it is possible to write the expression explicitly in the corresponding panel. The syntax is as follows:

Two "//" bars indicate that what follows until the end of the line is a comment and will not be interpreted.

Each state space variable X corresponding to the Room we are editing is identified as "$X_Name", "Name" being the name with which the variable is published in SimSEE. Cada variable del espacio de estado Y, corresponding to the Future Cost function to which we are hooking the room in edition, is identified as "$Y_Name". The assignment $Y=M(X)$ is then defined by several assignment statements of the type "$Y_Name := expression;", using as assignment operator ":=" and the expression being able to have definitions based on the standard operators: "+", "-", "*", "/" and standard functions such as log(), exp(), cos(), etc. Each expression must be endend width a semicolon ";".

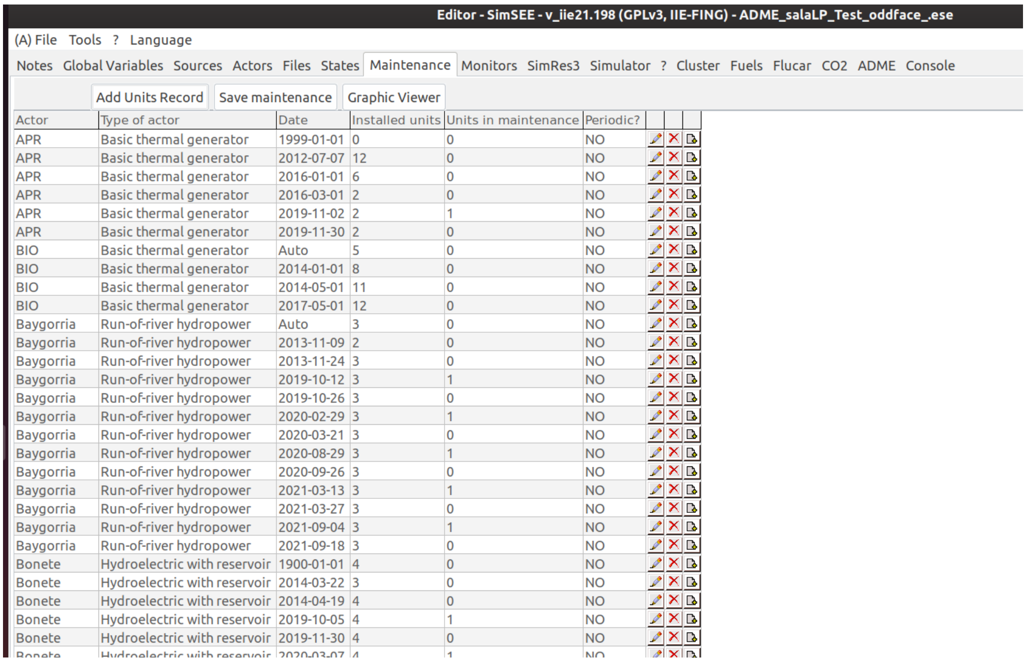
In the form in Fig.41, the "Hook Averaging Missing" box is applied only in the case of "Simple Mapping" and if that box is marked, the average of the Cost of Future in the discretization range of the variable is set average of the missing variable.

In the form in Fig.41, in the "Uniformize by averaging" field it is possible to enter a list of state variables (separated by ";" semicolon) for which you want to impose a constant CF value equal to the average of the values in the direction of each variable inclueded in the list. This uniformization is carried out at the end of the hooking in any of the types of mapping. This option is rarely used and was incorporated for research purposes.

Finally, at the bottom left in Fig.41, there is a **"Stabilize Last Frame"** box. If this box is checked, the stochastic dynamic programming algorithm is run several times over the last time step, trying to stabilize the CF function. The procedure consists in calculating the CF value at the beginning of the last time step of the optimization horizon from the CF value at the end of said time step, then copying the value obtained on the calculation start values and so on until the CF derivatives are stabilized with respect to the different directions of the state. This procedure is an alternative to defining a broader optimization horizon than the simulation horizon to leave a "guard time" for the algorithm to stabilize. As the result is approximately the same, it is preferable to choose to leave the "guard time" and leave this box unchecked, since in that way all the CF values will be recorded in the optimization output file, starting with the table of the beginning of the calculation and including the guard section. This allows a better visualization of the stabilization transient. If you choose to check the box and thus use the stabilization of the first calculation box, the possibility of inspecting the transient in the optimization output file is lost. On the other hand, if years of guarding are used, it is necessary to make the future projections relevant to the system (eg demand, available generation, etc.) that cover that "extended" horizon.

3.3.g) Maintenance Tab.

This tab shows in a single list all the records of units of the Generators and Markets present in the Room. An example of the display of the unit list is shown in Fig.43.



Actor	Type of actor	Date	Installed units	Units in maintenance	Periodic?
APR	Basic thermal generator	1999-01-01	0	0	NO
APR	Basic thermal generator	2012-07-07	12	0	NO
APR	Basic thermal generator	2016-01-01	6	0	NO
APR	Basic thermal generator	2016-03-01	2	0	NO
APR	Basic thermal generator	2019-11-02	2	1	NO
APR	Basic thermal generator	2019-11-30	2	0	NO
BIO	Basic thermal generator	Auto	5	0	NO
BIO	Basic thermal generator	2014-01-01	8	0	NO
BIO	Basic thermal generator	2014-05-01	11	0	NO
BIO	Basic thermal generator	2017-05-01	12	0	NO
Baygorria	Run-of-river hydropower	Auto	3	0	NO
Baygorria	Run-of-river hydropower	2013-11-09	2	0	NO
Baygorria	Run-of-river hydropower	2013-11-24	3	0	NO
Baygorria	Run-of-river hydropower	2019-10-12	3	1	NO
Baygorria	Run-of-river hydropower	2019-10-26	3	0	NO
Baygorria	Run-of-river hydropower	2020-02-29	3	1	NO
Baygorria	Run-of-river hydropower	2020-03-21	3	0	NO
Baygorria	Run-of-river hydropower	2020-08-29	3	1	NO
Baygorria	Run-of-river hydropower	2020-09-26	3	0	NO
Baygorria	Run-of-river hydropower	2021-03-13	3	1	NO
Baygorria	Run-of-river hydropower	2021-03-27	3	0	NO
Baygorria	Run-of-river hydropower	2021-09-04	3	1	NO
Baygorria	Run-of-river hydropower	2021-09-18	3	0	NO
Bonete	Hydroelectric with reservoir	1900-01-01	4	0	NO
Bonete	Hydroelectric with reservoir	2014-03-22	3	0	NO
Bonete	Hydroelectric with reservoir	2014-04-19	4	0	NO
Bonete	Hydroelectric with reservoir	2019-10-05	4	1	NO
Bonete	Hydroelectric with reservoir	2019-11-30	4	0	NO
Bonete	Hydroelectric with reservoir	2020-03-07	4	1	NO

Fig. 43: Maintenance tab.

As you can see, the name of the Actor, the type of Actor, the Date of the record, the number of units and whether the record is periodic or not is shown.

Pressing the “Graphic Viewer” button displays a screen like the one shown in Fig.44, which can be useful to identify problems in the configuration of the Room. By checking and unchecking in the panel on the right, the generators can be displayed or hidden. Each generator is displayed in a line and to the right, in the same line, the name of the generator and the maximum number of Units installed are shown. The proportion of installed units that are not in scheduled maintenance is shown in green, the proportion of units in scheduled maintenance is shown in red. Grays indicate that there are fewer units installed than the maximum on the horizon. A blank line indicates that this generator does not have any units installed on the horizon of the Room.

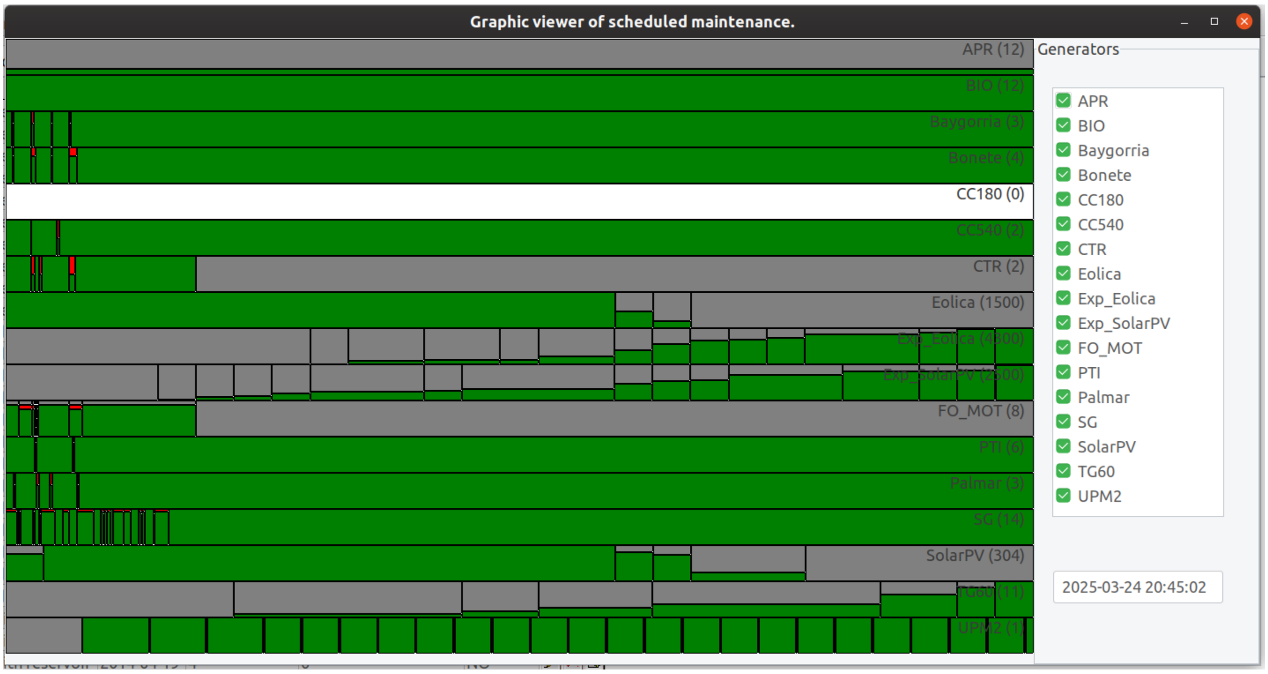


Fig. 44: Maintenance graphic viewer.

3.3.h) SimRes3 Tab.

This tab (see Fig.45) allows you to edit specifications of calculations to be performed with the "SimRes3" postprocessor.

As the figure shows, it is possible to add new specifications (this is to create a descriptive file of the calculations that is stored with the extension ".sr3"). When you press the pencil to edit a file, the SimRes3 Editor opens. The SimRes3 application and its editor (which is embedded within the room editor) is detailed in Volume 4 of these series of manuals.

If you want to add a previously created ".sr3" postprocessing sheet to the room, you must use the "Files" tab (see section 3.3.e)) and then return to the SimRes3 Tab and this template will appear in the list and you can edit it if required.

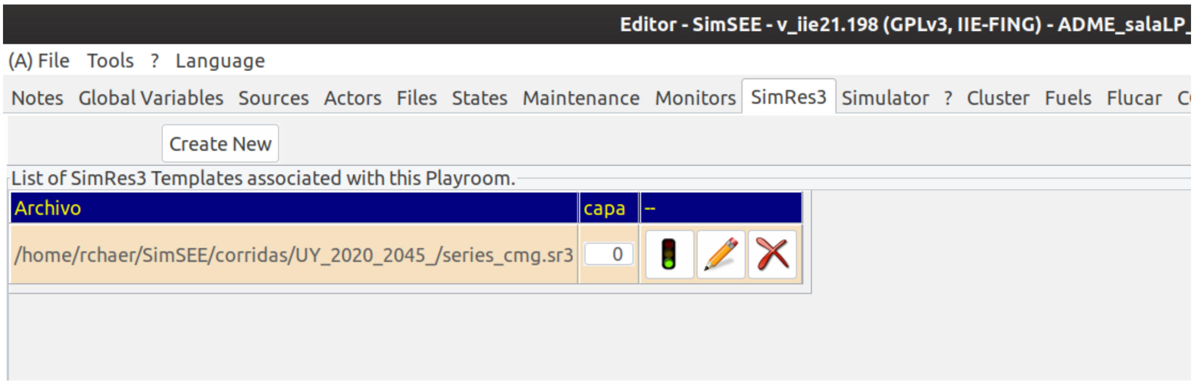


Fig. 45: SimRes3 Tab

3.3.i) Simulator Tab.

Once the Room has been edited (that is: specified the Global Variables, detailed the different Actors that you want to incorporate into the modeling, specifying their Maintenance and the Random Sources that will give them some service), the desired characteristics for the Simulation and Optimization stages must be specified in the **"Simulator"** tab.

As can be seen in Fig.46 there are three large panels “Optimization Variables”, “Simulation Variables” and “Scenarios”. The first two allow you to configure the parameters for the Optimization and Simulation stages respectively. The "Scenarios" panel allows you to configure the scenarios available in the Room and execute them.

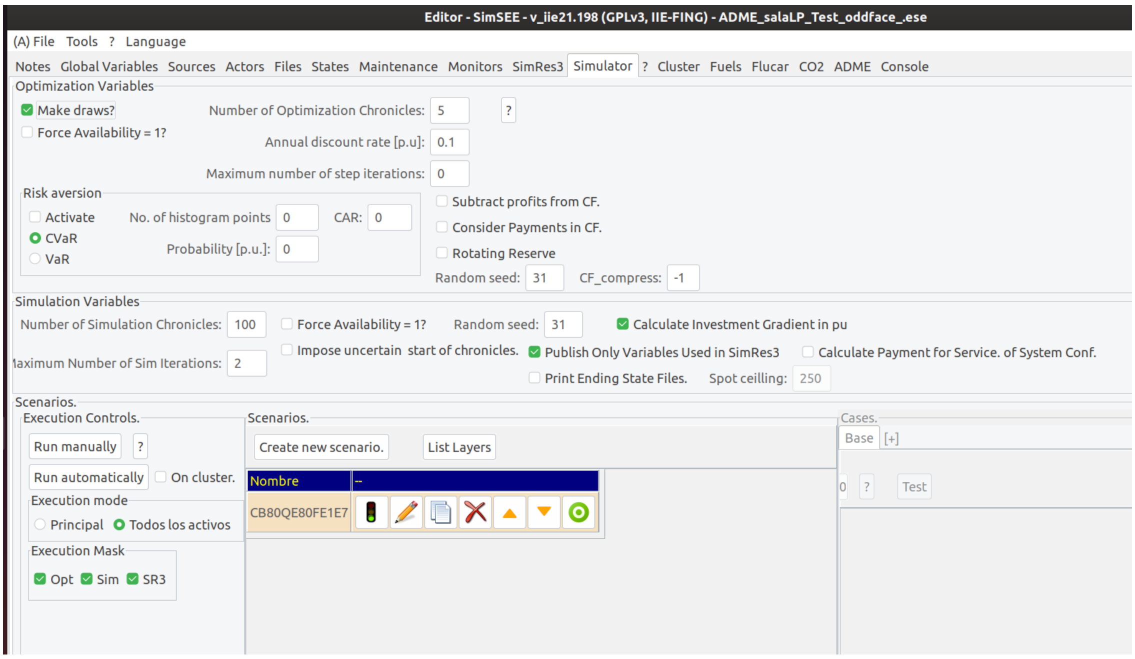


Fig. 46: Simulator Tab.

3.3.i.i Optimization parameters.

Checking the box **“Make Sweepstakes?”** Stochastic Dynamic Optimization is carried out by drawing random variables at each time step. If the box is not checked, the optimization is carried out considering at each time step the expected value of the random variables, instead of making draws (eg expected value of the power for the case of the generation plants calculated by multiplying the nominal power by the random availability coefficient, or expected value of the hydrological contributions in the case of hydraulic power plants). It is usual to use it marked and then perform a Stochastic Dynamic optimization. The unchecked box leads to a deterministic Dynamic optimization and generally leads to a sub-optimal and "more liberal" operating policy with the use of resources.

In the **“Number of Optimization Chronicles”** box you must enter the number of chronicles to be used to sort through each time step, if you have checked the “Make Sweepstakes?” box. If that option was not checked, this parameter is ignored. The greater the number of chronicles, the greater the amount of combinations actually considered of the stochastic processes that will be considered. The greater the number, the more likely it is that unlikely cases (such as the simultaneous breakage of many machines) will appear and therefore have an impact on the valuation of resources. The calculation time of the Optimization stage is directly proportional to the *Number of Optimization Chronicles*, so the value to be used is a compromise between accuracy and calculation speed.

The **“Force Availability = 1?”** box allows you to force the availability of all the machines in 1 (100%), not making random draw for them. This is useful at times when a result is difficult to interpret, as a way to detect if it is related to the breakage of the machines or has another origin. It is usually used unchecked.

“Annual Update Rate (p.u.)” is the annual update rate applied to the money for the calculation of the current value (the CF function (X) is the expected value of the updated cash flows). This rate must be greater than zero to ensure the stability of the optimization algorithm. A fair value can be between 0.08 and 0.12 (this is between 8% and 12% per year) for the case in which prices are expressed in constant dollars.

The **“Maximum Number of Opt Iterations”** sets the maximum number of iterations that will be allowed to be performed in the resolution of each step. The iteration mechanism allows to improve the accuracy of the model. In SimSEE, each Actor is responsible for supplying the equations of his model and through the iteration mechanism he is allowed to "change the equations" if the resulting operating point is far from the assumption in the previous iteration. An example of the application of this mechanism is the energy coefficient of hydroelectric plants, which, being affected by the flow rate, depends on the result of the step itself. When solving a step, each Actor performs a linearization of his equations around the supposed point of work and the problem is solved. When solving it, it may happen that the operating point is outside the range of validity of the assumed point when linearizing the model. If this occurs, the

Actor who is in that situation may require a new resolution of the step to have the opportunity to improve his equation. This "consultation of the Actors" is done until everyone confirms to agree with the result or until the maximum number of iterations established is reached. If set to 0, iterations are not allowed. A fair value can be eg 3 or 4.

The **“Rotating Reserve”** box allows the Rotating Reserve mechanism to be enabled, which means imposing, in addition to the balance of powers demanded and delivered in each node, imposing the balance between demand and supply of rotating reserve in each node.

The **"Risk Aversion"** panel below can be activated / deactivated using the **"Activate"** box (by default it is unchecked). It implements risk management in optimization, allowing to choose between using the **“VaR”** (Value at Risk) or **“CVaR”** (Conditional Value at Risk) as cost dispersion measures.

The **“CAR”** (Risk Aversion Coefficient) box must specify a number between 0.0 and 1.0 that will indicate the degree of risk aversion to be used.

If it is CAR = 0.0 it is not risk averse and optimization will minimize the expected value of the future cost function (which is the same as not activating risk aversion).

If instead the user has maximum risk aversion, enter CAR = 1.0. This implies that the optimization will try to minimize "high costs" (instead of the expected value of the costs). The measure of “high costs” will be the value that is exceeded with a probability P (specified in the “Probability” box) or the expected value of costs that exceed that probability P as selected as a “VaR” or “ CVaR ” risk measure respectively.

For intermediate values of the Risk Aversion Coefficient, the objective function to be minimized will be a linear combination between the expected value of the costs and the measure of dispersion that has been selected.

The **"Probability (p.u.)"** box determines the exceedance probability limit set by the user to measure the cost dispersion of a given histogram (this is a way of measuring risk exposure). VaR (P) is the value that is exceeded with probability P. CVaR (P) is the expected value of costs that exceed VaR (P).

The value **“Number of points of the histogram”** determines the “fineness” with which the histograms of the Future Cost CF (X, k) function are elaborated, that is, at each stage k of the optimization, not only the expected value of future cost for each discretization of the state variable Xwill be represented, but there will be a distribution or histogram (with as many points as specified) that will be those that allow to calculate the future cost values with the probability of exceedance that the user set. A typical value to use is 200 when the probability is 0.05.

The **“Subtract CF utilities”** box if checked, instead of minimizing the expected value of future cost, will minimize costs by subtracting the utilities obtained by the user. This is planned so that the Actors can determine in addition to the cost incurred over time, the profit generated. For an example of a model that specifies utilities, see the “Manageable Uses” Actor in Volume 3 of this series of manuals. The normal use of this box is marked and has no consequences on the calculation time.

The **“Consider Payments in CF”** box allows you to specify whether additional payments (for power made available and for energy) that are not considered in the dispatch resolution are or are not added to the Future Cost (CF) function. When added, the optimizer takes them into account and the operation policy can be influenced if the operator had some (operational) mechanism that allows him to reduce payments. By way of example only, if a “payment for energy” is specified in one hydroelectric plant and in another it is not specified, when there are excesses of energy that give rise to dumping, the optimized one will give preference to open the dumps of the plant that would be paid to deliver the energy.

The **"Random seed"** field allows you to specify a seed to initialize the random number generators used in the Optimization stage. Changing this number is useful to estimate the accuracy of the results with the number of draws specified. If the results are sensitive to the initial seed it means that the amount of raffles should be increased.

The **"CF_compress"** field by default is -1 and implies that a compressed representation of the Future Cost will be used when stored in the binary file. If 0 (Zero) is specified, no compression is performed.

3.3.i.ii Simulation parameters.

The **"Number of Simulation Chronicles"** determines the number of chronicles that will be simulated. Each chronicle is simulated separately. Simulating a chronicle means that in each time step (from the first to the last of the simulation time horizon) the corresponding draws will be made to obtain the values to be considered for all random variables.

The **“Force Availability = 1?”** Box allows you to force the availability of all the machines in 1 (100%), not making random draw for them. It is advisable not to check this box and use the potential of the platform. The box is for purposes of analyzing the effects of whether or not to consider accidental breakage in simulations.

The box **"Maximum Number of Sim. Iterations"** allows you to set the maximum number of iterations that are allowed in a time step to improve the modeling of the different actors. (see the same optimization parameter above).

The “Obligatory start of uncertain chronicle” box allows you to specify that all unit records (see sec.3.3.d.i) behave as if they had marked the *beginning of uncertain chronicle.*

The **"Random seed"** field determines the seed with which all random number generators used during the simulation are initialized. By varying this number, different sets of simulation chronicles can be generated and thus determine the accuracy of the results based on the number of chronicles used.

The **“Publish Only Variables Used in SimRes3”** field should be used marked and it means that in the files that are generated with the results of the simulations only those variables that are then used in any of the SimRes3 files associated with the Room are saved. All the entities of the Room publish (declare) variables that can then be used in the calculations with SimRes3. If the box is not checked, all the variables are registered in the output files even if they are not referenced in SimRes3 files, which leads to quickly have files of unmanageable size. The option to uncheck the box is made available only for academic purposes.

The **“Print End of State Files”** box also has academic objectives and has the effect that if checked, text files are generated with the System State record at the end of each simulated chronicle.

The **“Calculate investment gradients in p.u.”** box specifies whether the Investment Gradients of those Actors for which their calculation is specified is done per unit or in USD (dollars).

With the box unchecked at each time step for each Actor in which calculation is marked, the investment gradient (GradInv) is calculated as: $GradInv := E * CMG - Costos$. The energy delivered by the generator valued at the marginal cost of the node minus the cost of generation and less payments not considered in the dispatch (availability and energy). If the box is marked, it is done as:

$$GradInv := (E * CMG - Costos) / Pago\_por\_disponibilidad$$

The **“Calculate Payment for Service” of System Conf. ”** box enables the calculation of the participation of generators and demands in the System Reliability Service. It is calculated for each Actor and two variables are published: SCS Participation and SCS Forcing. The **“Spot Roof”** box specifies the limit value used for the sanction of the Spot price based on the marginal cost. If the Marginal Cost exceeds the Roof value, the spot price is set to the roof value and in that case, the Participation and Forcing variables in the SCS that correspond to the energy exchanged (to the node to which it is connected) valued at the Marginal Cost Marginal minus the value specified as “Spot Roof” or the variable cost of generation if it is higher are calculated. In the event that the variable generation cost is higher than the Roof, ForcingSCS is assigned the amount corresponding to the Energy for the difference between the roof and the variable cost.

The pseudo calculation code is the one shown below:

```
ParticipacionSCS:= 0;
ForzamientoSCS:=0;
CmgMenosTecho:= CMG - TechoDelSpot;
if  CmgMenosTecho > 0  then
begin
     TechoMenosCV:= TechoDelSpot - CV_spot;
     if  TechoMenosCV > 0 then
       ParticipacionSCS:= E *  CmgMenosTecho
     else
     begin
        ParticipacionSCS:= E * ( CMG - CV_Spot );
        ForzamientoSCS:= E * (-TechoMenosCV) ;
     end
end
```

3.3.i.iii Scenarios.

In the **“Scenarios”** panel, using the **“Create new scenario”** button, several simulation scenarios (or cases) can be created in the same Room, thus avoiding duplicating the information and facilitating the maintenance of the case set.

A scenario is defined by indicating which are the active layers in that scenario. Dynamic parameter records have a parameter that is the layer, and this allows to have sets of records that are activated or not according to the scenario. By default, all the records are in layer 0 (zero), which corresponds to the "Base" scenario, but it is possible to specify dynamic parameter records with a different layer number (1, 2, 3, etc.). Two records can have the same start date, but if they are specified with different layer number, each one will be activated in the scenario that activates the layer to which it belongs.

This facilitates the creation of small variants of the same Room in the form of **"Scenarios"**. A scenario has a "name" that identifies it and a set of active layers that will be considered in Optimization and Simulation. Layers that are not active DO NOT participate in Optimization or Simulation of the scenario. (They are removed from the room before performing the Optimization and / or Simulation).

Once a scenario is created, it can be activated / deactivated, edited, deleted and marked / unmarked as the main stage of the simulation, using different available buttons. The meaning of the buttons is as follows:

"Traffic light" that allows you to activate / deactivate the stage. If it is deactivated it will have a red background. If the "Execute Automatically" button is pressed, the active scenarios are executed automatically without the user having to intervene.

"Pencil" that allows you to edit and modify the scenario.

"Duplicate" allows you to clone a scenario.

"Cross" that eliminates the scenario.

"Up arrow" allows you to move the stage up in the list of available scenarios.

"Down arrow" allows you to move the stage down in the list of available scenarios.

"Principal", a red mark that indicates the main scenario (only one can be at a time). This will be the optimized / simulated scenario when the Simulator is invoked by pressing the "Run manually" button.

When editing a scenario, a form like the one in Fig.47 opens.

Fig. 47: Edition form of a Scenario.

In it, it is possible to specify a **"Name"** that is assigned to the scenario and detail the **"Active Layers"**, that is, those that will be taken into account for the Optimization and / or Simulation in that scenario. It also presents a window where it is possible to make a brief description of it. By means of two boxes at the bottom it is possible to mark if this scenario will be used to **Optimize** and / or to **Simulate**. In the example in the figure, the dynamic parameter tabs that have layer values 0, 1, 2, 3 and 4 will all be active. The elements that are in the other layers (eg layer = 5) will not be considered in the scenario called "ConAra_BioPPI" shown in the example. Usually layer 0 (Base) will be included in all scenarios, and the corresponding layers will be added to the variants that you want to specify.

The functionality of the boxes that allow to specify "optimize" and "simulate" is planned for a future version of SimSEE that will allow the set of active scenarios to be executed in BATCH mode in the order listed.

The **"List Layers"** button generates a page and displays it in your internet browser with the list of the Scenarios and the parameter records located in each layer.

3.3.i.iv Call Optimizer / Simulator with the main scenario

Finally, with the **"Call Optimizer / Simulator with the main scenario"** button located further to the right in the window corresponding to the "Simulator" tab (see Fig.46), it is possible to invoke the SIMULATOR program for the main scenario. For details on the operation of the same see the chapter 4 of the present Manual.

A possible example of the use of scenarios may be with a Demand Actor who may want to add an additional component in a scenario and not consider that component in the baseline study scenario, the modeling of the rest of the system being the same in both cases. One possibility is to make 2 separate rooms, identical except in that modification, optimize and simulate both separately. By managing scenarios it is possible to do it in a single room. A component that will be a random source will then be associated with the Demand Actor, which will have a record with a null value in layer = 1 and the value of the additional demand in another record in layer 2. Two scenarios will be registered: in one of them the active layers will be 0 and 1, while in the other the active layers will be 0 and 2. When optimizing / simulating the first one, SimSEE will not take into account the values specified in layer 2 (that is, you will not see the additional demand component that was specified with layer = 2, because that layer is inactive in that scenario), while optimizing / simulating the second scenario, it will take it into account (since this layer is active).

It is thus possible to introduce small variants to the Room (that is, different scenarios), without needing to duplicate all the information every time.

3.3.j) ? Tab.

When trying to activate this tab, the browser configured by default is opened and a web page is accessed with the help information on the Main Tab Bar of the SimSEE Editor.

3.3.k) Fuels

In the **"Fuels"** tab it is possible to define types of fuels that can be used by the Actors that are accessed in the "Actors-> Fuel Network" sub-tab. If you do not use these types of actors, it is not necessary to define types of fuels in the Room. Fig.48 shows an example of the content of the tab with three types of fuels defined.

Fig. 48: Fuel tab.

Pressing the **"Add Fuel"** button or the editing button for a fuel in the list, the form in Fig.49 is displayed. As you can see, it allows defining the name of the fuel and a list of dynamic parameter records.

The dynamic parameters form is the one shown in Fig.50. As dynamic parameters of fuels it is necessary to specify the density, the upper and lower calorific value. The buttons on the "Load typical values" panel are useful for loading typical values according to the type of fuel. These parameters are specified as dynamic to allow considering possible changes in them such as a change of provider in certain seasons of the year.

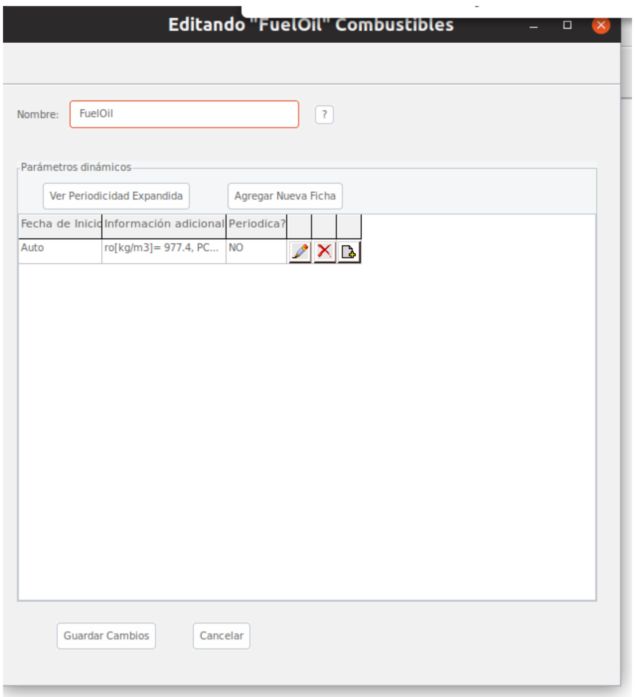


Fig. 49: Edition of a type of fuel.

Fig. 50: Características del combustible.

3.3.l) CO2 Tab.

This tab (see Fig.51) allows you to specify the characteristics of the generators for the calculation of CO2 emissions.

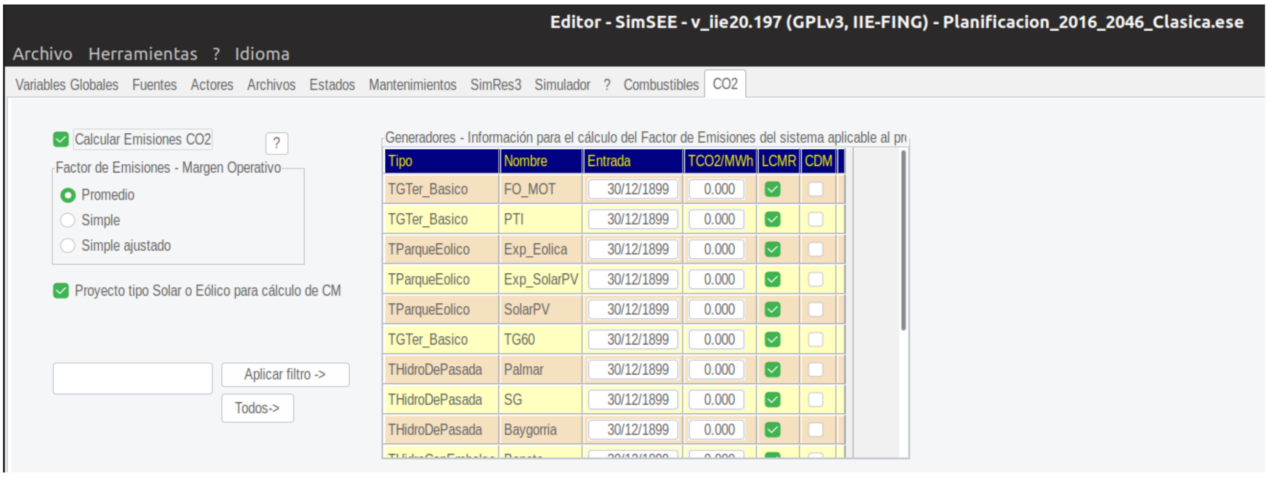


Fig. 51: CO2 Tab

The *Calculate CO2 Emissions* box enables or not the calculation. If enabled, it is generated by simulating a file with the expected emission of each generator, with different indicators.

This improvement to SimSEE was developed within the framework of the ANII_FSE_2009_18 project within the framework of the Sectorial Energy Fund of the ANII. The final report of said project is in:
http://iie.fing.edu.uy/simsee/biblioteca/anii_fse_2009_18/memoria_fse_2009_18_MejorasSimSEE.pdf

4. The Optimizer/Simulator.

This chapter is the "SimSEESimulator.exe" Application User Manual. In SimSEE terms, this application is called “The Simulator” and is in charge of the different the steps of Optimization and Simulation over a Room.

In the most common use of the SimSEE platform, the simulator is directly called from the Editor (the Editor application is described in sec.3.3), but it can also be manually called or by using a script or batch command to execute a sequence of simulations.

To run the Simulator from the Editor, you must press the "Manually Run" button that is in the "Simulator" tab (see sec.3.3).

Fig.52 shows the Simulator's screen. As may be appreciated, there is a top panel called "Entry Data", which specifies the Room file to be processed. If the Simulator has been summoned from the Editor, this field appears already filled in with the Editor’s Room file. In case that the Simulator is opened directly with the “Select Room” button, a browser will open which will allow you to select the Room file to be executed.

At the bottom is the “Alerts” panel, where there will be any alert messages about dubious definitions or errors detected during the loading of the Room.

The main part of the screen (Fig.52) is fomed by the “Optimize”, “Simulate”, “SimRes3” and “Auxiliary” tabs.

4.1. Optimize Tab.

The “Optimize” tab is the one that unfolds in Fig.52. In the "Parameters" panel the values specified in the Room are loaded. If you change these values and press the “Optimize” button, the changes will only be effective for ongoing optimization and will not be stored in the Room. The possibility of making changes in this panel is only to the effect of being able to make tests on the effect of the parameters. If you want to change them permanently you should do it in the Editor. The meaning of each parameter is explained in the section “3.2.h.i) Optimization Patameters”.

When the Optimization is performed, the folder for the simulation outputs is created {$HOME}/SimSEE/rundir/{$sala} a file with the name “CF_{$escenario}.bin”, where:

{$HOME} is generally “C:\” in case you use Windows or your personal folder in case you use Linux.

{$sala} is the name of the file of the Room without extension. We recommend that you do not use spaces or symbols in room file names to avoid inconvenients with changes of operating systems or character encoding according to the language.

{$escenario} is the name of the scenario marked as "active" within the Room. (The same recommendations are valid regarding the name of the room.

If, when loading the Room, it is detected that the file "CF _ {scenario} .bin" already exists, the "Load CF (own)" button is enabled, which allows you to load that file as if you had performed the Optimization.

After finishing the Optimization or loading the file "CF _ {scenario} .bin", if it already existed, the content of the "Simulation" tab will be enabled.

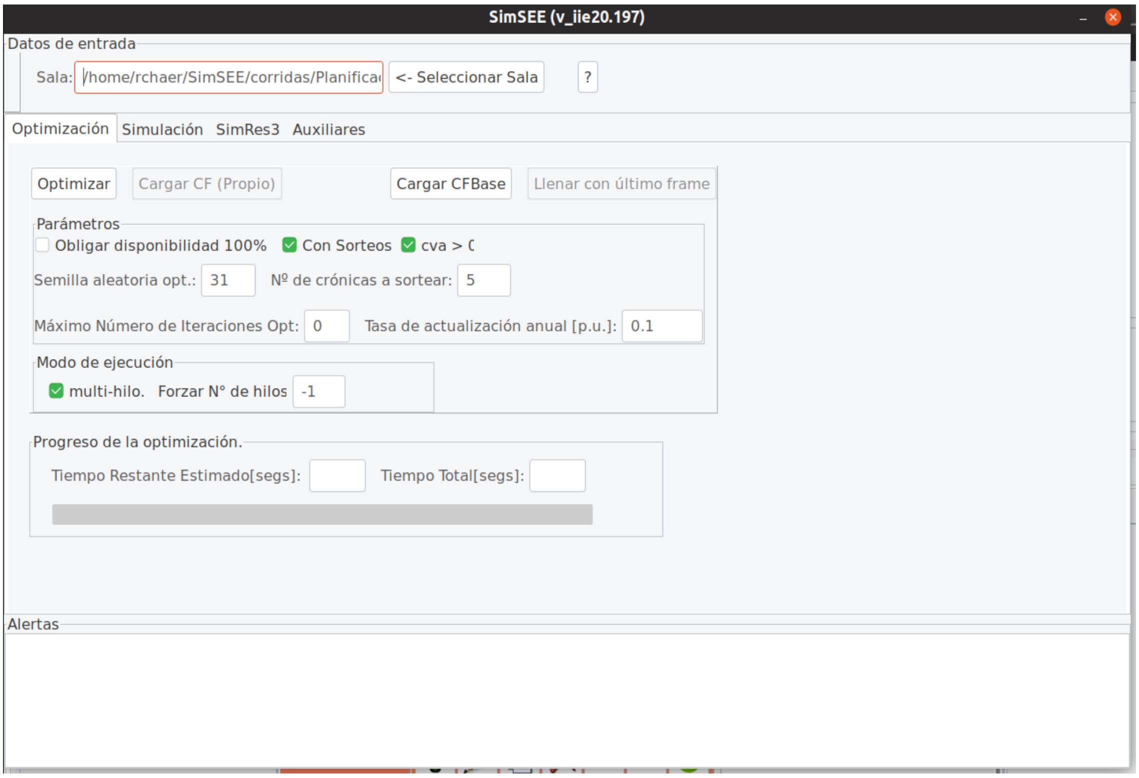


Fig. 52: Simulator screen.

The "Load CFBase" button opens a browser and allows you to select a Future Cost file (CF _ ?????. Bin) from your computer to be used. It allows you to upload files that may correspond to Rooms with time steps of different length from the current Room and the simulator interpolates the information over time. This functionality was designed to perform simulations of hourly time steps with CF files _ ????. Bin result of Rooms with the same description of the state space, but of daily steps.

The "Execution mode" panel allows you to modify the way the calculation is performed. By default, the "multi-thread" box is marked, which indicates that you will try to use several threads (parallel calculation robots) for execution, and the "Force No. of threads" field with default value "-1" (minus one) indicating that as many threads are used as processors (calculation cores) are detected as available on the computer. This configuration is the most efficient, but sometimes you may want to impose the number of threads, for example not to overload the equipment, indicating a positive number in the "Force No. of threads" field. You can also deactivate the functionality completely by unchecking the "multi-thread" box and then the optimization will be executed without parallelizing the calculation in several threads.

The "Optimization Progress" panel shows the elapsed time and the remaining time in seconds, and the progress bar moves accordingly.

4.2. Simulation Tab

The "Simulation" tab, see Fig.53 is enabled after the optimization has been carried out or the loading of a CF was performed using as explained in section 4.1.

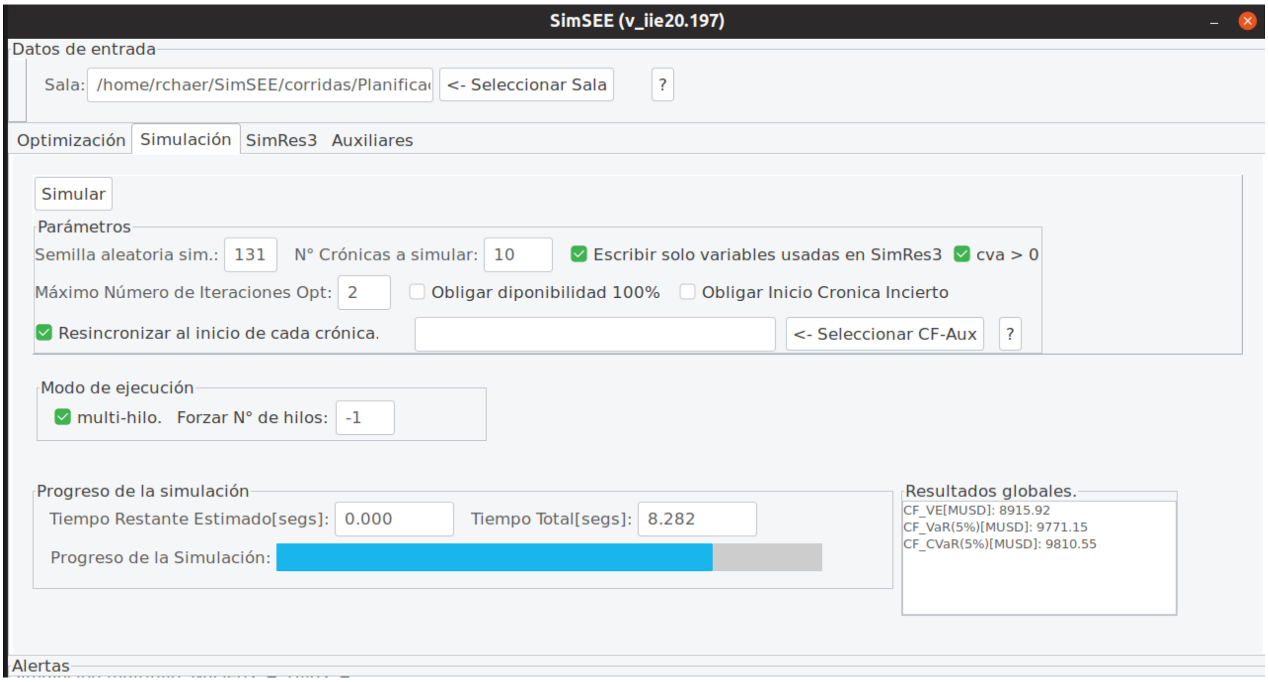


Fig. 53: Simulation Tab.

The "Simulate" button launches the simulation of the Room using the CF (result of optimization or loading).

In the "Parameters" panel are the parameters applicable to the Simulation that were explained in sec.3.3.h.ii "Simulation Parameters".

The "Execution mode" panel allows you to enable or not multithreaded execution and indicate the number of threads to be used. A value "-1" in the field "Force No. of threads:" implies that as many threads will be used as processors detected in the computer, if multi-thread execution is enabled. If a positive value is entered, the number of threads specified will be created regardless of the number of available processors.

The "Simulation Progress" panel allows you to observe the progress of the simulation.

The "Global results" panel displays a summary of the results of the total simulated chronicles. The values correspond to the Future Cost of the operation, in expected value, which is exceeded only by 5% of the chronicles and the average of 5% of higher value.

Once the simulation is finished, the “SimRes3” tab is automatically activated, so if you want to observe the summary, you must manually return to the “Simulate” tab.

The summary values are also in the text file that is stored in the results directory {$ HOME} / SimSEE / rundir / {$ room} with the name “simcosto _ {$ seed} x {$ nchronics} _ {$ scenario } .xlt. "

Where: {$seed} is the random seed used for simulation, {$ nchronics} is the amount of simulation chronicles and {$ scenario} is the name of the simulated scenario.

4.3. *SimRes3 Tab.*

At the end of the Simulation, the “SimRes3” tab is used to execute the SimRes3 results postprocessor (see Volume 4 of this series of manuals).

The results processing is described in scripts or SimRes3 Templates stored in files linked to the Room as explained in sec.3.3.g) “SimRes3 Tab” (of the Editor).

Fig.54 shows the content of the SimRes3 tab of the simulator. The combo - selector will allow you to select the SimRes3 template to be executed, and pressing the “Execute SimRes3” button will execute the SimRes3 program using the template selected on the results of the simulation just performed. The radio selector “html - Excel” allows you to select whether the output of SimRes3 is done in html format or as an Excel workbook.

Fig. 54: SimRes3 Tab of the Simulator.

If html is selected, it is created in a sub-folder of the folder in which the Room is located with the result sheets (in plain text format with tabulator as data separator and “.” (period) as decimal separator. In the same folder, the graphics that have been specified and an “index.html” page are generated. That page is opened in the default browser as shown in Fig. 55. As you can see, there is a “Data” panel with links to the data files and then “Graphics” with the generated images.

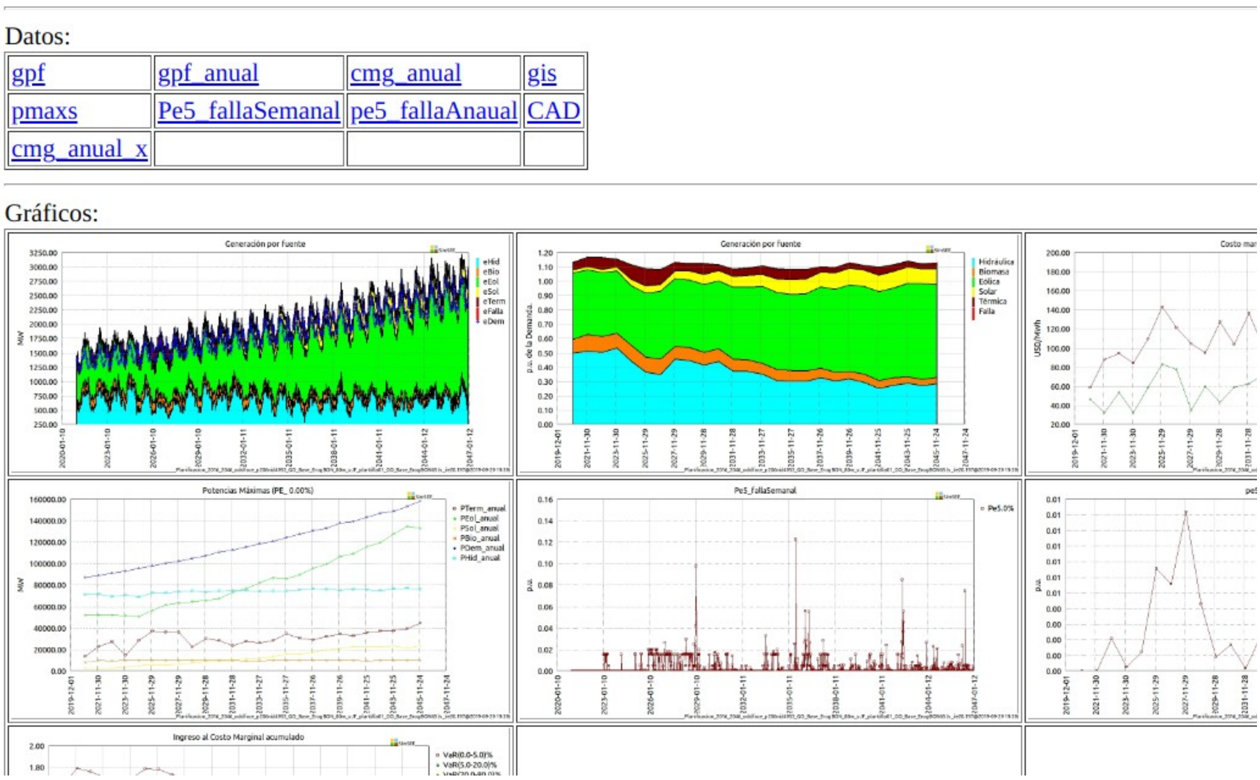


Fig. 55: Example of a SimRes3 html output.

The option to generate in Excel generates the same information by directly writing an Excel workbook. To use this option you must use Windows Operating System and have Excel installed. This option has been difficult to maintain due to changes in the Excel application and because it is not portable to Linux and is very likely to be discontinued in the future; therefore it is advisable to use the "html" option.

4.4. Auxiliaries Tab.

The Auxiliaries Flap is available when the Room is loaded and can be used to generate a summary of the units installed of the Actors in the Simulation Horizon by pressing the “Units.Disp.” Button and two files with the firm power available from the thermal generators by pressing the "Imp.Pot.Firmes" button.

Fig. 56: Auxiliaries Tab of the Simulator.

Files are created in the results directory {$HOME}/SimSEE/rundir/{$ room} with the following names:

Archive of installed units:
{$ room} _U _ scenario} .xlt

Available thermal power file:
potencias_Termicas_Firmes_porpaso_{$escenario}.xlt

Monthly available thermal power file:
potencias_Termicas_Firmes_mensuales_{$escenario}.xlt

2. cmdopt Parameters.

The only mandatory parameter is the "sala"

Eg. to run the optimization with different a random seed=10031 and 10 chronicles the commad line is:-
cmdopt sala=c:\SimSEE\corridas\miSala.ese semilla=10031 ncronicasopt=10

```
cmdopt
  sala={archivo_sala}
  escenario={nombre_del_escenaro,''}
  nhilos={nHilosForzados,-1}
  ntareas={nTareasForzadas,-1}
  cf={archivo_enganche_cf,''}
  semilla={valor,randomize,''}
  ncronicasopt={valor,''}
```

3. cmdsim Parameters.

The only mandatory parameter is the "sala".

Eg. to run the simulation with different a random seed=10031 and 10 chronicles the commad line and with a given "cf" file is:-

cmdsim sala=c:\SimSEE\corridas\miSala.ese semilla=10031 ncronicassim=100 cf=c:\Simsee\rundir\miSala\{given_cf_file}

```
cmdsim
  sala={nombre_archivo}
  escenario={nombre_del_escenario,''}
  nhilos={nHilosForzados,-1}
  ntareas={nTareasForzadas,-1}
  cf={archivo_CF}
  semilla={valor,randomize,''}
  ncronicassim={valor,''}
  sr3={no,xlt,srb}
```