5
CEE Application Scenarios

This chapter describes some scenarios for applying the CEE. First, we present the project of Collaborative Risers Analysis Workflow. Second, we describe the case of a Design Review Workflow of an engineering project where the support provided by CEE infrastructure allows the creation of a collaborative visualization session for Design Review.

5.1.
Collaborative Risers Analysis Workflow

Over the last ten years there has been a significant effort to develop offshore oil&gas reserves from ultra deeper water. One of the main challenges associated with deep-water field development is the riser system, necessary to transport the production fluids from the seabed to the floating production facilities.

Floating production units (oil platforms) use ascending pipes, called risers, to bring the oil from the wellhead on the sea floor to the oil platform's separator system tanks. The risers are connected to the platform using special connections called "joints". To certificate the operation of the risers for their entire life cycle (30 years or so), simulations of the stress applied to the riser system are conducted based on meteo-oceanographic data about wind, tide and water currents. In order to avoid operational problems, simulations are made under extreme environment conditions to test against stress resistance. In our case we have used a riser analysis software called Anflex [MGJ95], an internally developed Finite-Element-based structural analysis package.

5.1.1.
BPEL Scientific Workflow

We have defined an Anflex-based riser analysis workflow controlled by the BPEL engine for automating the validation process and certification of riser analysis [SCJ+02]. The workflow integrates the execution of the following services: *Ocean Service, Anflex Service e Grid Job Service.* This workflow was described in section 3.4, where we mentioned that before running the engineering simulations, the loading cases must be prepared using a pre-informed Anflex base-case, prepared with Anflex Pre-processor, AnflexGUI. In Figure 5.1 we show the final version of the Riser analysis workflow in a BPEL designer, in this case a plugin for the Eclipse development tool [EclipseBPEL].

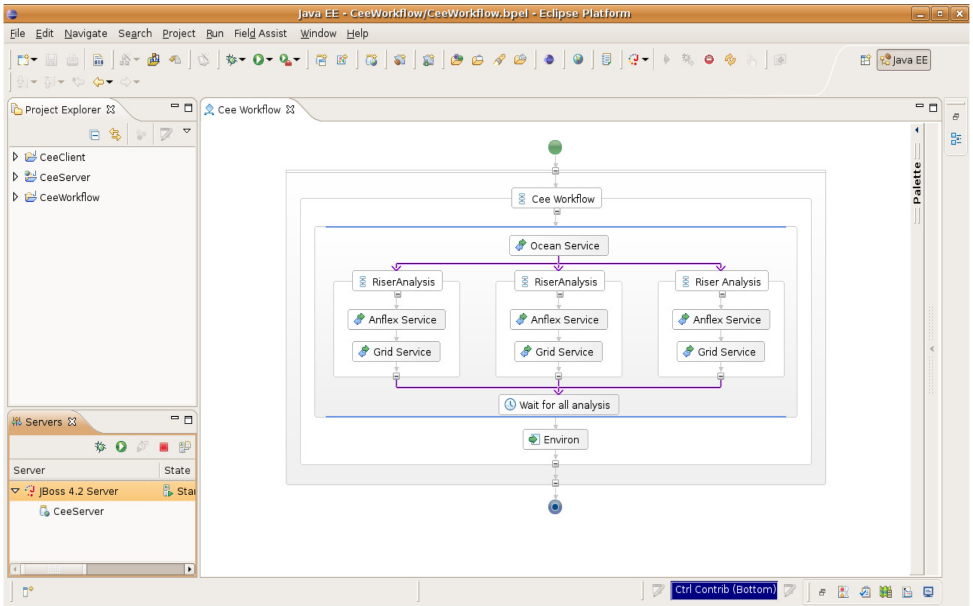


Figure 5.1: Constructing the Riser Analysis workflow on BPEL Designer.

The workflow starts with an Anflex base-case, where the basic configuration of the experiment is defined such as a production unit, riser's geometry, soil bathymetry, etc. *Anflex Service* receives user input parameters from BPEL designer and is responsible for creating different loading cases according to the different meteo-oceanographic conditions provided by the *OceanService*. After that, BPEL instructs CEE *GridJob Service* to communicate with Condor to submit jobs for executing the Anflex simulation program on the available nodes of the Numerical Grid.

Upon finishing the execution of Condor jobs, Anflex Service is called again to select the worst cases that will be analyzed in a *Collaborative Visualization Session* created by the CEE *Service Coordinator*. The VC Service is available at anytime providing human to human interaction for solving conflicts. To start the *Collaborative Visualization Session,* the *Service Coordinator* is called to start the session. The *Service Coordinator* uses the ESB infrastructure to invoke the execution of the *Environ Service* to start the session. *Environ Service* then starts *Environ Proxy* and the Environ Application. *Environ Proxy* communicates with Environ by a TCP socket connection for sending and receiving commands. The

Collaboration Manager Service starts the *JMS Collaboration Bus* to allow users to exchange commands among themselves using the instance of *Environ Proxy*.

Figure 5.2 depicts the Sessions created in this situation. In this specific situation both users have the *Scientific Workflow Service, Environ Service, and the CSVTool service* initiated, which means that they will have a support for executing a Videoconference and also are able to execute the Anflex program.

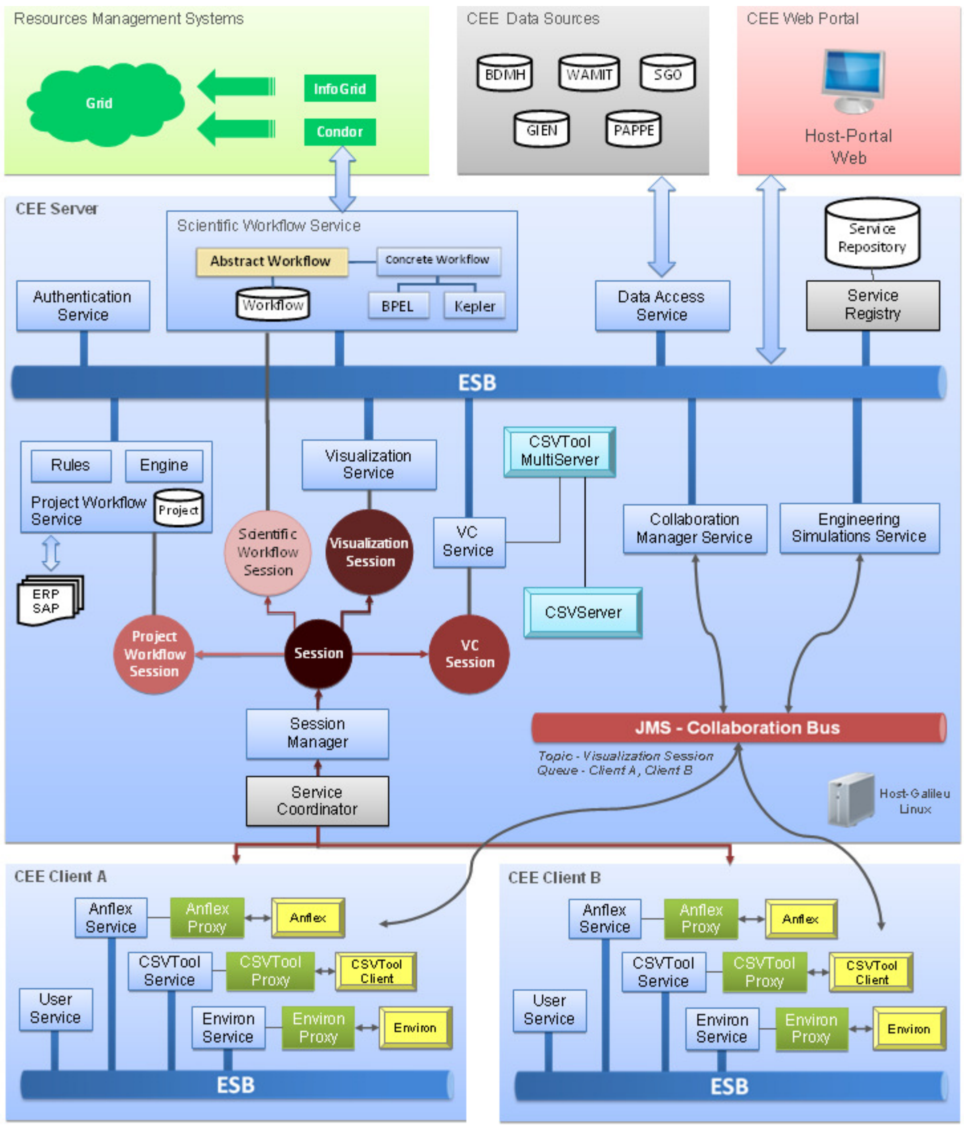


Figure 5.2: CEE SOA state of execution of a Riser Analysis Workflow.

5.1.2.
Video Conferencing

Figure 5.3 shows a collaborative visualization session with the presence of two users, represented by two distinct 3D-cursors, visualizing the simulation results in their desktop with the support of a Videoconference using the *CSVTool*.

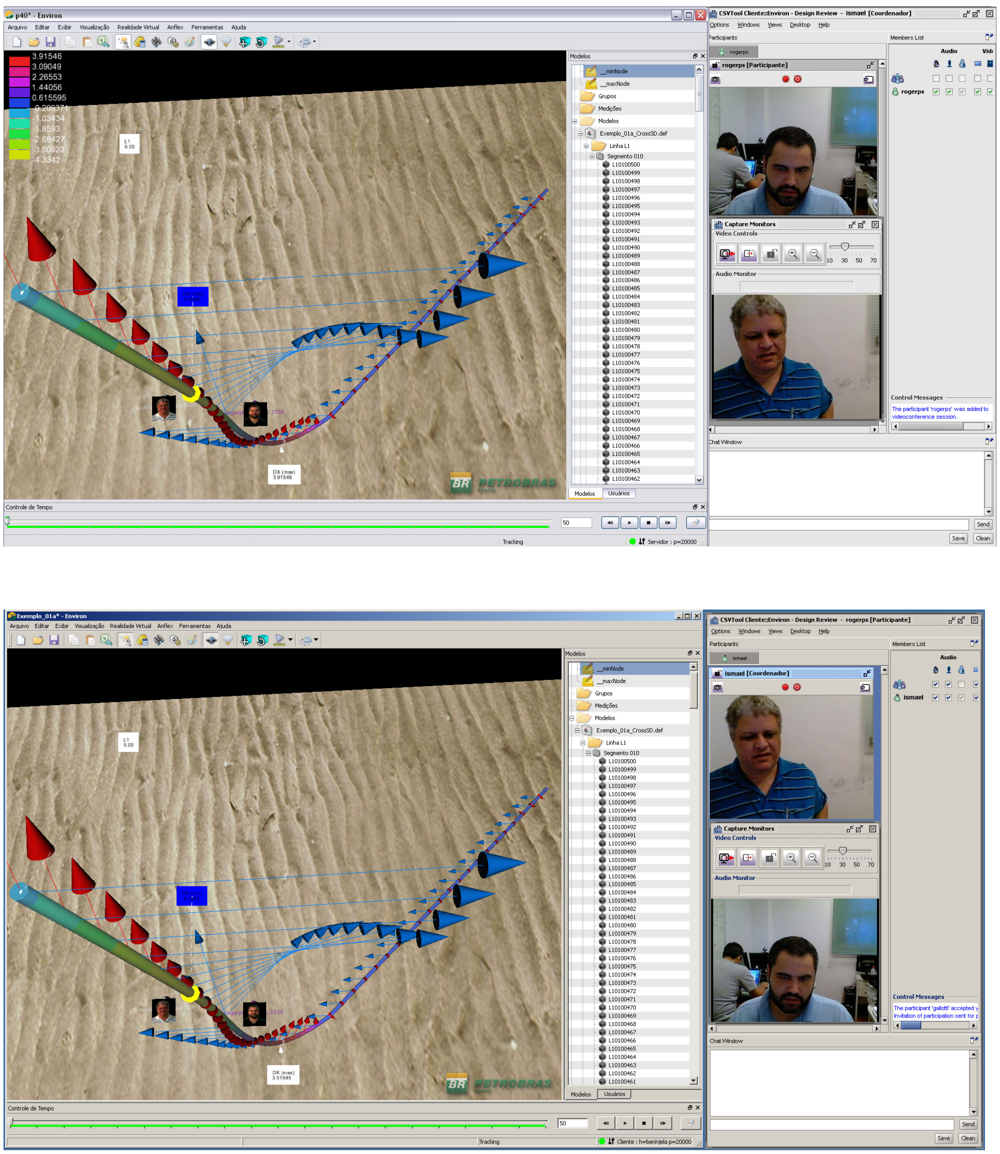


Figure 5.3: Riser Analysis in CEE (Environ + CSV Tool).

The blue arrow represents the water currents that actuate over the riser, while the red arrow represents the direction of the movement of the riser (i.e. instantaneous velocity). Observe that the greater the alignment of those two groups of arrows the greater the influence of the water currents in the final movement of the riser. For that situation we can see that there is no such alignment, which means that other environmental forces (winds and waves) have a greater influence in the final movement of the riser.

In the first picture appears the coordinator's desktop, user ismael, while in the second appears the participant's desktop, user rogerps. Note that, the coordinator receives a video stream from the participant, while in the second picture the participant receives the image of the coordinator. This way the efficiency of the collaboration is dramatically improved due to the user Awareness obtained by the use of CSVTool, where the users can see each other and also receive a screen copy of the remote user desktop. Each user is represented by its own avatar associated with the position of its telepointers. The transmission of the desktop image among users in same times is very important, especially when a user wants to show input parameters of an application or wants to teach how to make an operation to the other user.

5.1.3. 3D Annotations

Environ has special capabilities to show the extreme values and where are they located. 3D Annotations can also be created by the users. In Figure 5.3 two 3D annotations were created automatically by the Environ, showing the extreme points (maximum and minimum values) of a selected force or strength in the riser. The third 3D annotation was created by one of the users to register some important observation made in this collaborative session.

Among other resources, it is possible to playback the simulation, examine pipes, sea waves and ship movements, and track elements in the risers that are subjected to extreme conditions (e.g., high stress values). It is also possible to select any element in a riser and examine it carefully; especially those elements in places subjected to great stress, such as the joints connection and the TDP (Touch Down Point). In Figure 5.4, the users are looking closely to the behavior of a selected element in the riser (green ring), they can also follow the movements of the element playing the simulation on the timeline bar.

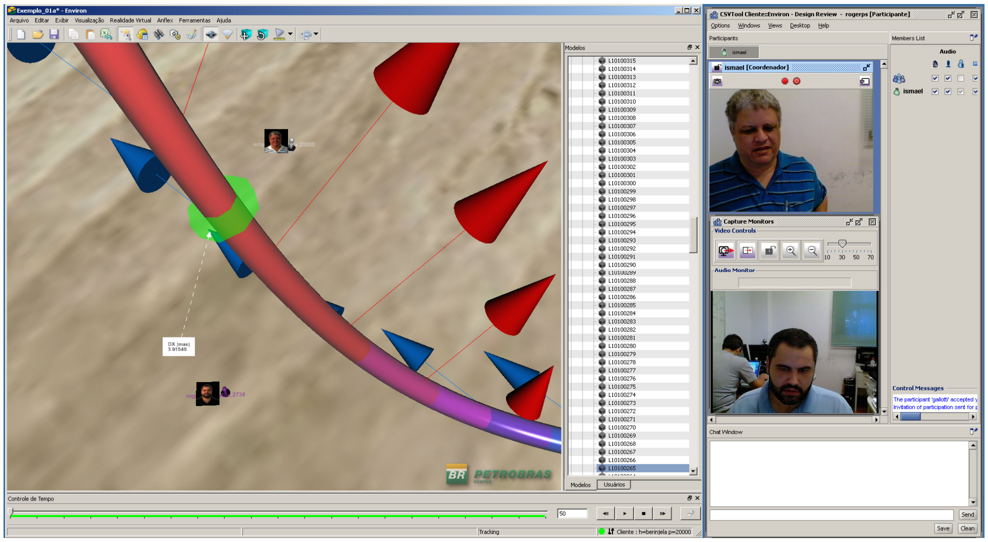
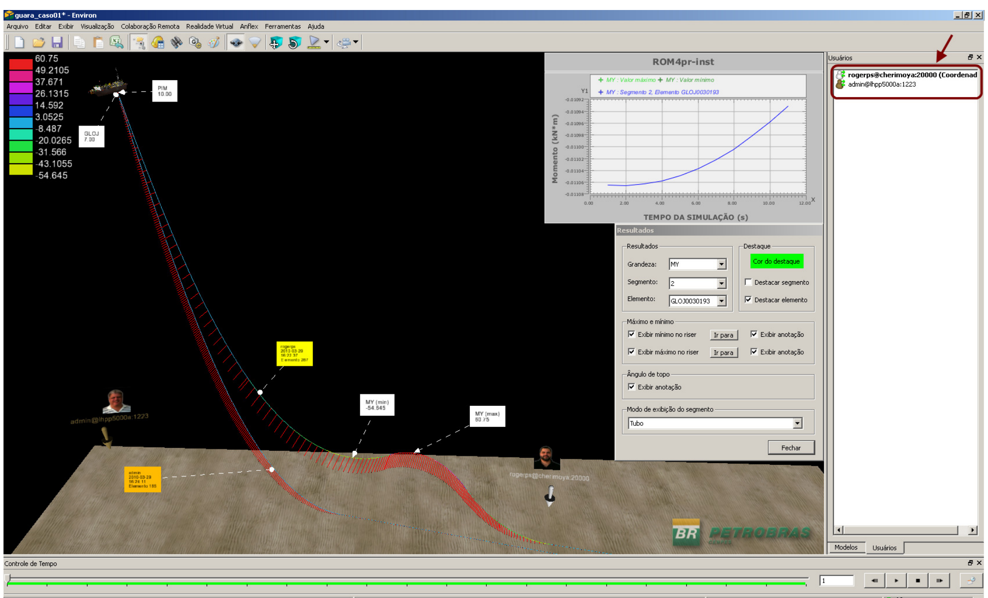


Figure 5.4: Closer look on an element of the riser

At the end of the session both users will have all the information attached to the model. This information represents the state of the collaborative visualization session and can be persisted in a file that can be loaded again in the future to reconstitute the scenario that was analyzed.



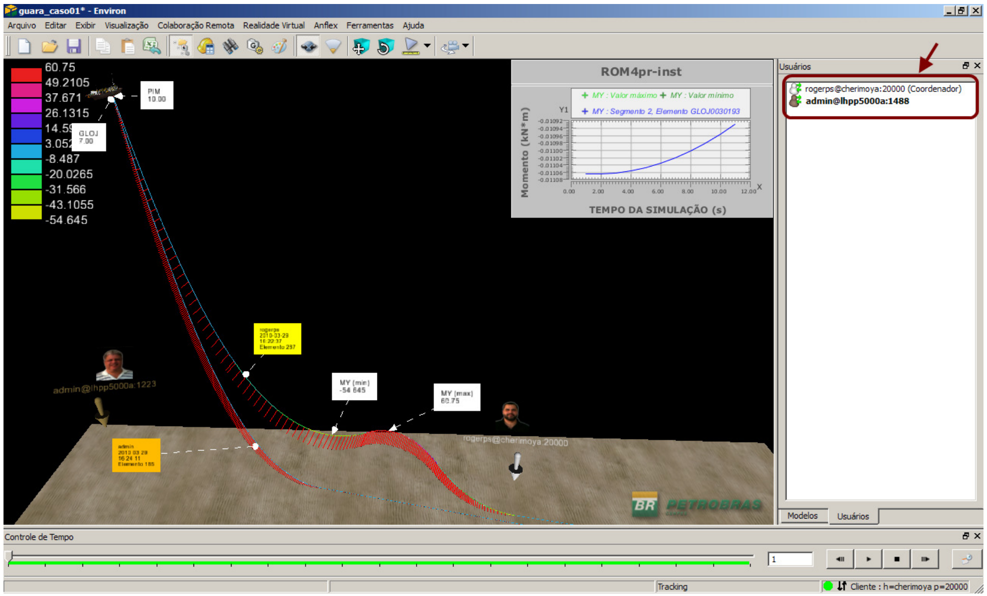


Figure 5.5: Two users in a CEE collaborative visualization session.

Figure 5.5 shows another collaborative visualization session now with another set of risers. Those pictures show the white 3D annotations created automatically by Environ, and two other annotations created by each user, making comments about different elements in those two risers.

Observe that in the users tab, we have the awareness mechanism showing information about the status of the user (online, offline) and its role in the session (coordinator or participant).

5.1.4. 3D Measurements

In Figure 5.6, we show a sequence of measurements created by the users, in this case was a 3D distance between two distinct points on the risers. The sequence of images shows the animation that can be seen by the users when they want to monitor that distance. In riser analysis this is important because the engineers have to avoid collisions between risers in order to preserve structurally the risers during their entire life (usually 20 to 30 years).

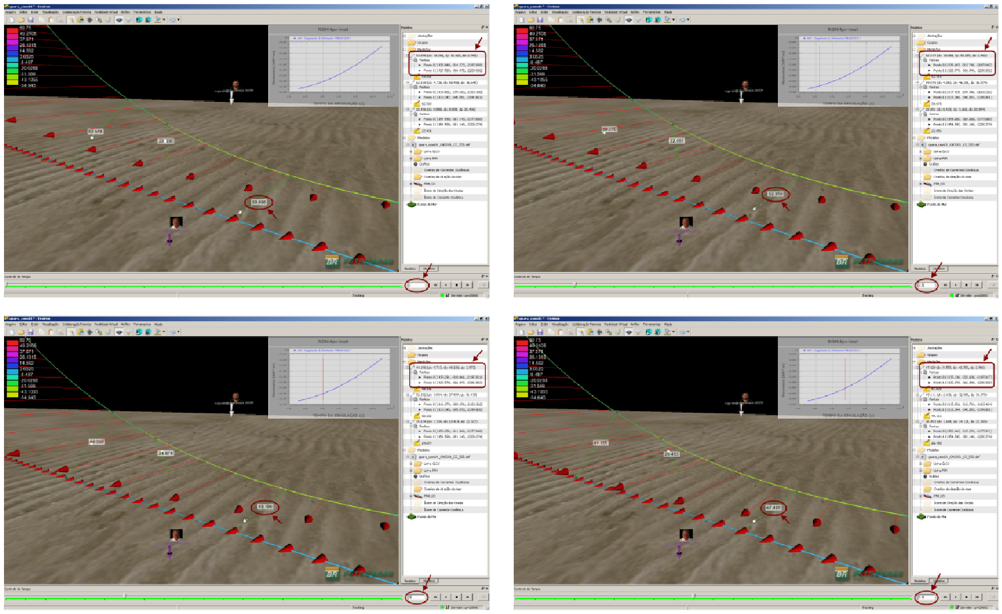
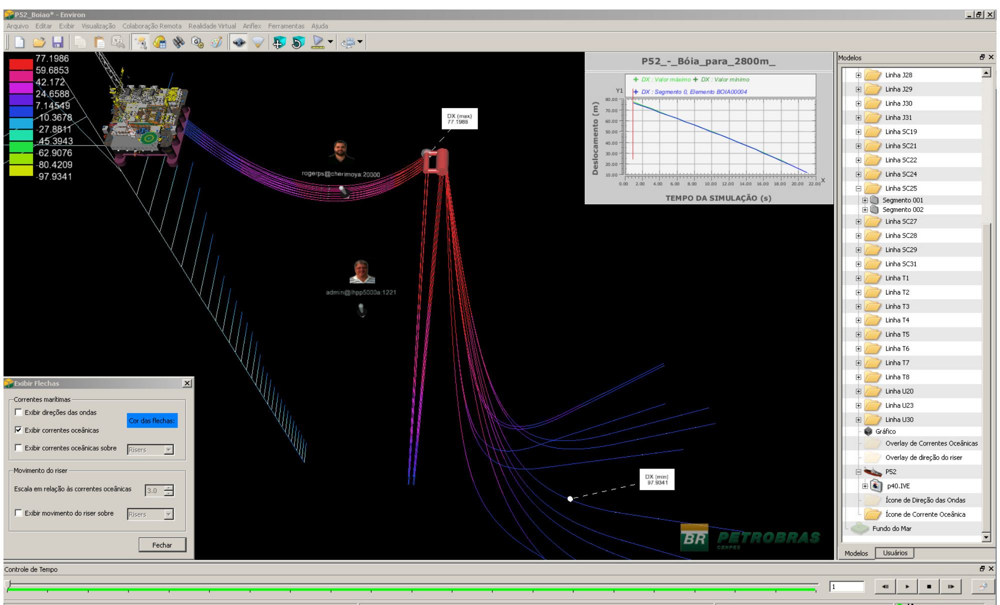


Figure 5.6: Measurments in a visualization session



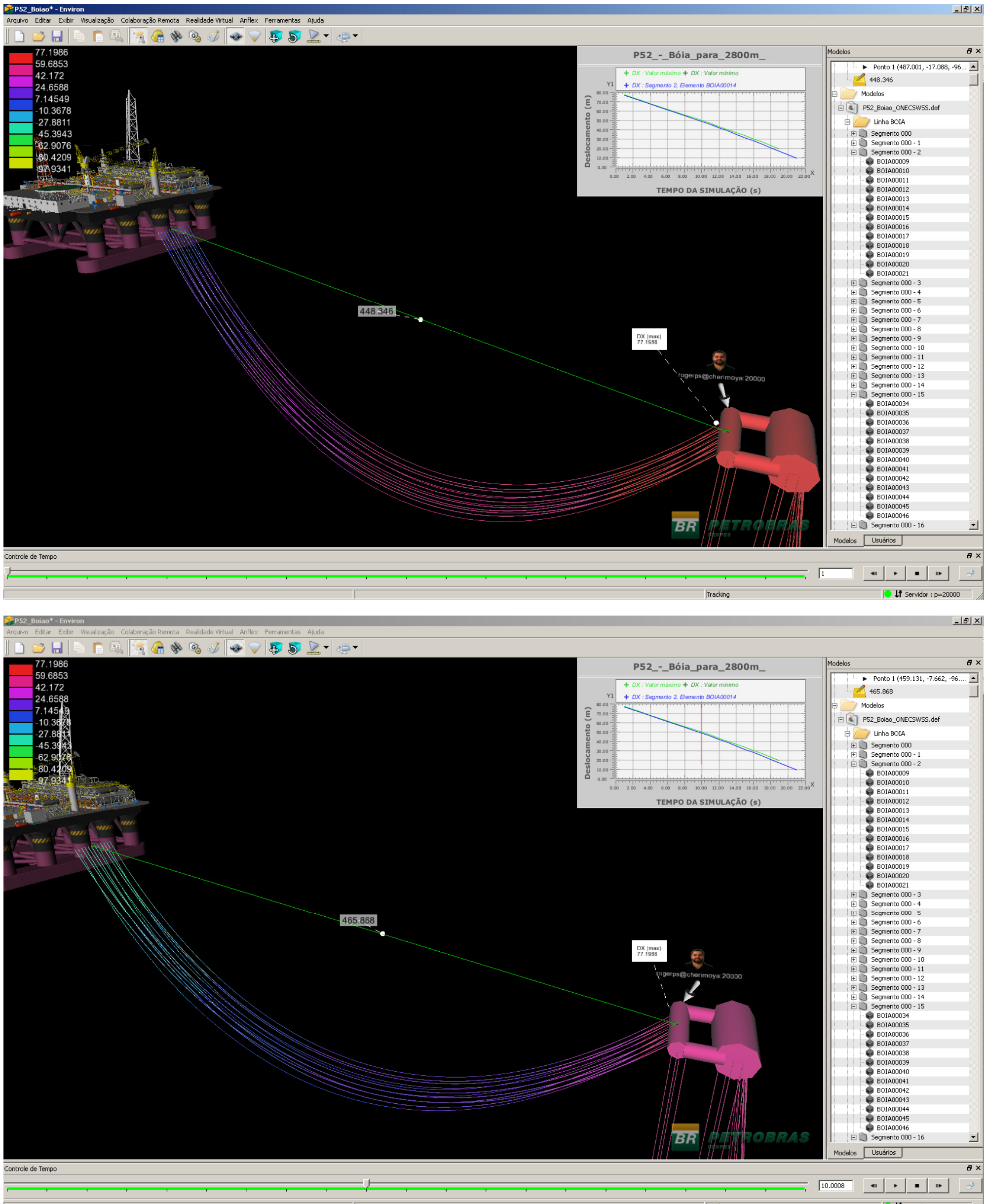


Figure 5.7: Users monitoring the behavior of marine buoyant

In Figure 5.7, we show another engineering project where the users want to study the movement of a buoyant, the usage of the buoyant is to reduce the stress that are submitted the risers especially when there is a great fluctuation in the platform movements due to strong environmental conditions (wave and winds). Through the use of the buoyant we can decouple the movement of the platform hull and the movement of the riser system. In the sequence of figures engineers is monitoring the distance between the buoyant and the platform and also are observing the behavior of some force on the risers.

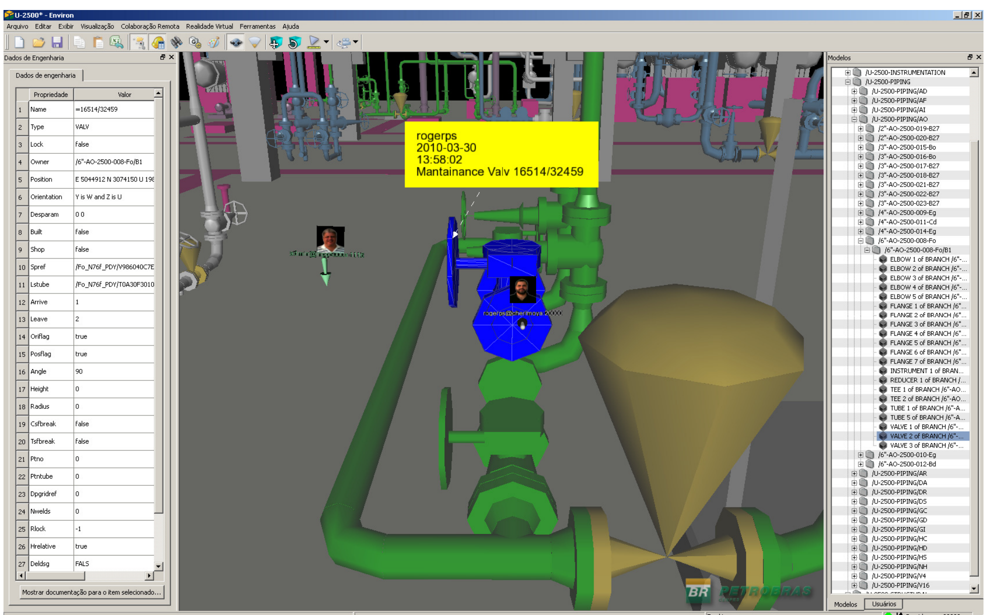
5.2. Design Review Workflow

Design review is the process of checking the correctness and consistency of an engineering project, and making the necessary corrections to it. CEE is very helpful in this process, for instance to assess the safeness of different emergency escape pathways in case of an emergency in the plant.

The Design Review workflow is a simplified version of the riser analysis workflow, where BPEL engine invokes *Service Coordinator* to create a *Collaborative Visualization Session* with the support o *VC Session* according to the user's choice. In this session the users manipulate engineering artifacts and create 3D annotations and make 3D measurements in the model.

Object manipulation is an important resource in design review. The ability of moving, rotating and scaling objects is important for various purposes such as joining different models in a scene, viewing hidden portions of the model, planning the placement of a new piece of equipment on a plant, and simulating a maintenance or intervention operation in a process plant are also valuable tools. As an example, the maintenance plan can be enriched with a detailed sequence of operations with annotations carefully chosen to be presented as an animation for the maintenance engineers during the operation (

Figure 5.8). Moreover, integration with a database is useful to allow user to create annotations on the model emphasizing critical parts. It is also possible to show comments attached to objects, which can be used, for example, as recommendations for project management.



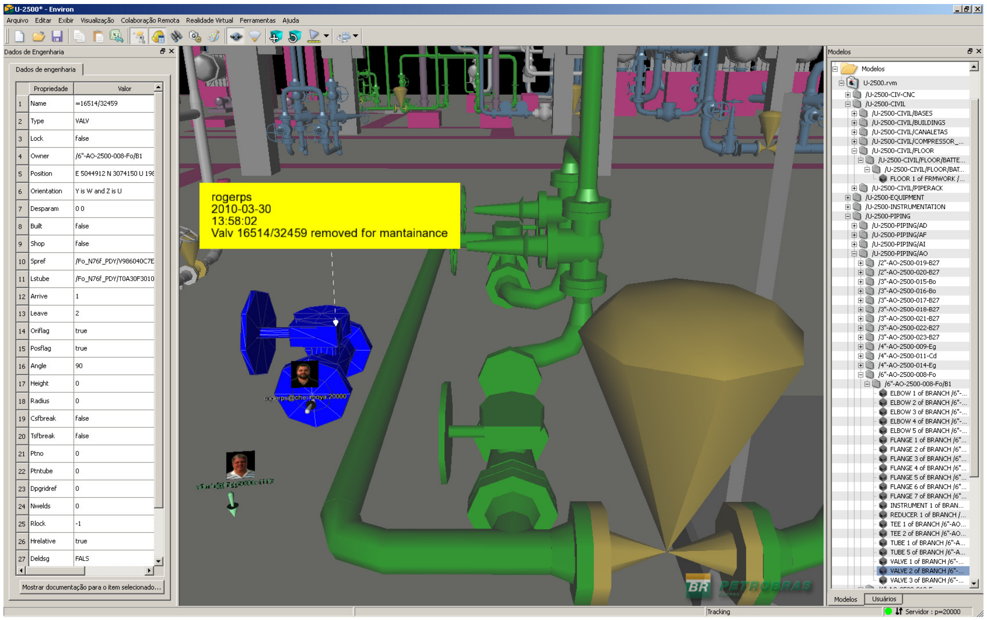


Figure 5.8: Maintenance plan enriched with annotations.

Figure 5.9 shows some measurements taken for planning the movement of a large tank on production unit. The users creates a lot of 3D annotations to guide the maintenance process.

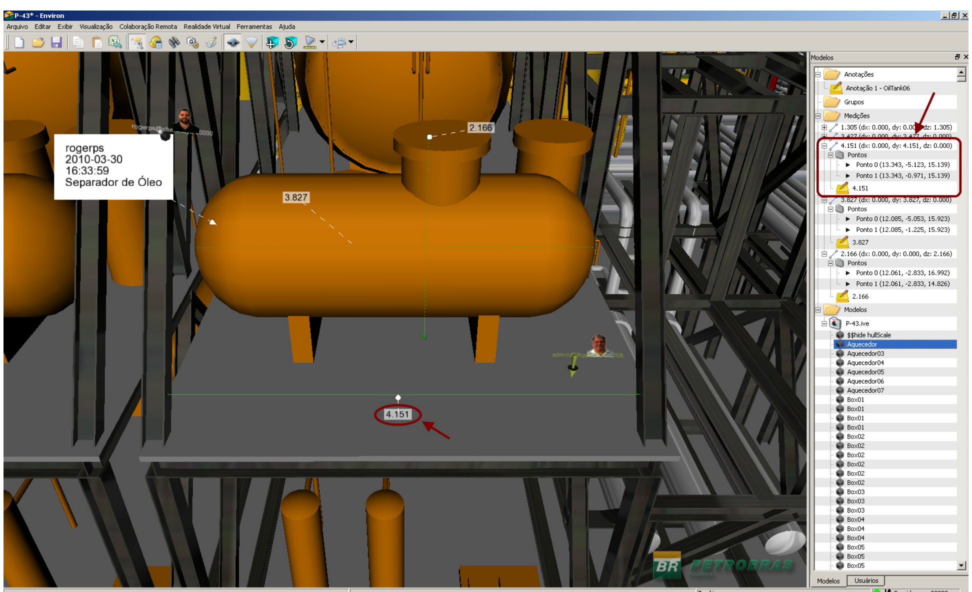


Figure 5.9: Measurements in a CAD.

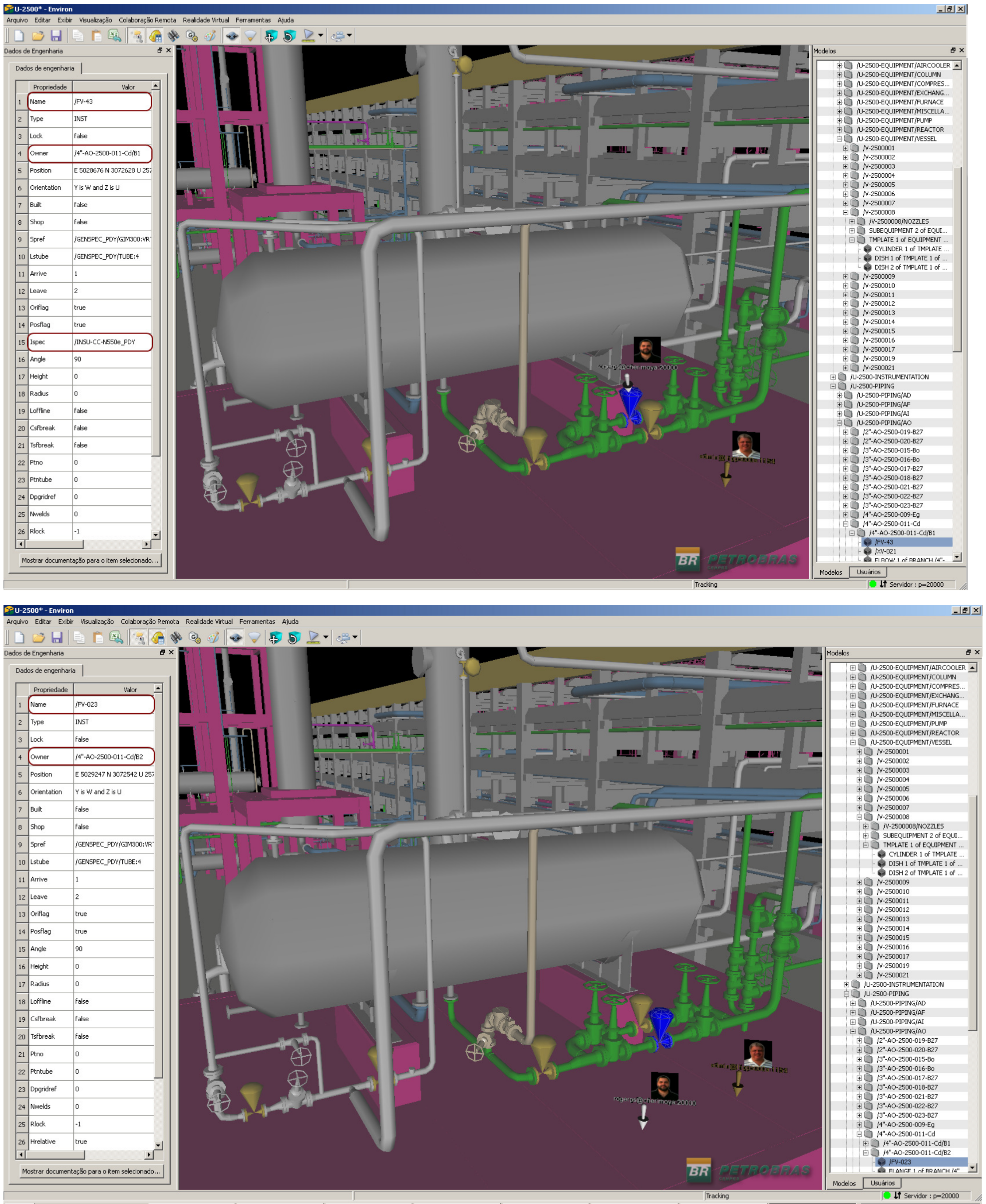


Figure 5.10: Engineering information.

Another important aspect in design review is the integration of the visualized model with project information. Several CAD models have technical information attached to each object. Using database resources it is possible to recover this information in real time and use it to help the user taking operational decisions. Figure 5.10 shows a simple window with information on a gas tank. It is possible to know what is the pressure that is actuating in a valve once there is a connection with an real time measurement system, such as ECOS-PI, very well known in the oil industry.

5.2.1. Virtual Guided Tour

The final interesting tool in Environ is the *Virtual Guided Tour*, where a user follows the movements of another user, sharing the same view of the model. Figure 5.11 shows another collaborative visualization session now on a platform. The pictures show both users following a 3D path passing through important points and at the end an annotation is created to mark some important event on the platform, maintenance or commission of new equipment could be programmed.

As we mentioned in Chapter 3, we have three types of sessions (Informal, Classroom and Lecture). So for each type of session the user has a status that is determined according to its role (coordinator or participant). In a Virtual Guided Tour the coordinator is in a state that he can only send camera movements and must ignore any camera movements from the other users (SendOnly), while all the other participants are in a state that they can only receive commands and cannot send any camera movements (ReceiveOnly).

In the first image both users are in a SendAndReceive state, because we are in an Informal collaboration session. The awareness mechanism shows the icons of each user with 2 green lights, one for input and another for output. When changing to a Classroom or Lecture collaborative session the state of the coordinator and participant changes accordingly, as shown in the picture of Figure 5.11. Observe that the awareness mechanism changes the icons of each user accordingly, the coordinator change its state to SendOnly (upper arrow green, lower arrow red) while the participant change its state to ReceiveOnly (upper arrow red, lower arrow green).

In Environ there is also a possibility of requesting the coordinator role, but only when we are in a Classroom collaborative session. When in a Lecture session this possibility is forbidden by the definition of a Lecture, see Chapter 3.

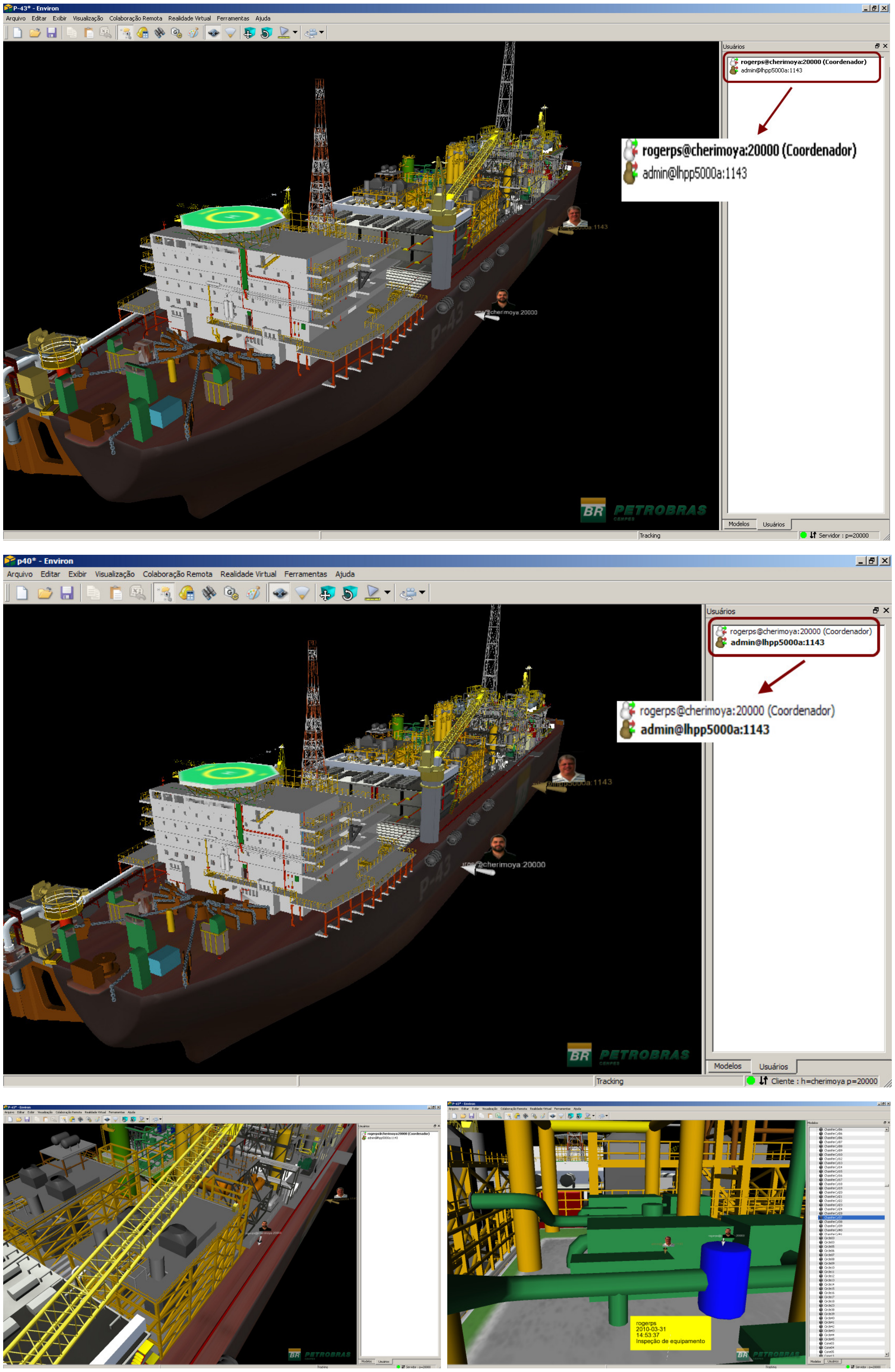


Figure 5.11: Virtual Guided Tour