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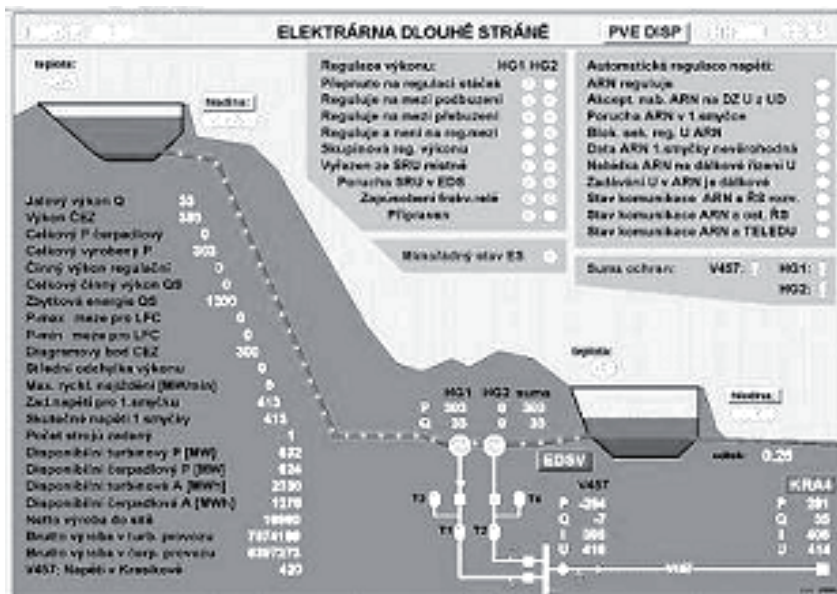
Visualisation of the pumped storage hydroelectric plant Dlouhé Stráně and its use in education

Visualisation is a modern phenomenon of the present time. Visualisation of technological processes is an important element for optimization of controlling difficult technical systems. We have modern technical instruments for recording. Among these instruments there are computer, came cord, digital cameras, data projectors, visualisers etc. Necessary condition for creation and presentation of a record is software, at the most of instruments. In our case it is software for creation digital records made in practice. In the story there is mentioned demonstration of working in the pumped storage hydroelectric plant Dlouhé Stráně. There is filmed a short video at the dispatching centre from the aspect of controlling the power station by a shift-dispatcher. From it, it is possible to see if the power station is running and create or use electricity. And also what capacity is in the lead, what is a voltage, stage of water in the upper and lower basin etc. This visualisation can be called dynamic, when the process is recorded in the way that we can see the changes in working of the power station from the record at the specific time section. We can also define the static visualisation which shows us the specific view on the specific appliance at the specific time moment i.e. the view on the distribution point of the station, turbine, block transformer etc. Such records can be made by digital cameras and the outcome is a photo-documentation, where, through suitable browsers, we can do viewing of the equipment of the power station. In conditions of teaching at schools it is possible to familiarize students with working of the station (thanks to a computer and a data projector) from the aspect of controlling (dynamic visualisation – video) and view of the viewing and interpretation of the power station (static visualisation - photo documentation).

Description of the Power Station Dlouhé Stráně

The pumped storage hydroelectric plant Dlouhé Stráně is situated by the river Divoká Desná in Jeseníky Mountains, at the village of Loučná nad Desnou in the county of Šumperk. Its function is to fulfil static and dynamic services for electro energetic system of our republic by its capacity of 650 MW. Static services are effective change of energy excess in the system to peak energy. This process takes place by

pumping water from the lower basin into the upper basin in time of its excess and to the contrary – by production of electric energy by the turbine operation. Among dynamic services, there belongs mainly a share of the station in the regulation of capacity and of an electricity cycle in system and a function of the prompt reserve in system. Water from the upper basin, situated in 1350 ms above the level of the sea, is lead by two pressure feeders with the average of 3,6 ms and length 1,5 kms into turbines. Both reverse machine sets, each with the capacity of 325 MW, are situated in the underground cavern of turbines with the length of 87 ms, wide of 25,5 ms and high of 50 ms. Block transformers are situated in the underground chamber with the length of 117 ms, wide of 17 ms and high of 21,5ms. In the underground there are also communication, technological and ventilation tunnels and tunnels with the complete length of 8,5kms. Underground power station is joined with the lower basin by two runaway tunnels with the inner diameter of 5,2 ms. A capacity is lead from underground by cables with the voltage of 400 kW metal-enclosed distribution board and from there by outer cable with the length of 52 kms into the distribution point in Krasíkov.



Ryc. 1. Animated working of the hydroelectric plant

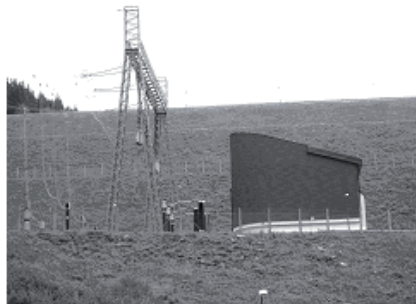
The Dynamic Visualisation and its Application in Example of the Hydroelectric Plant Working

The term of a dynamic visualisation of a digital record means that a specific process is recorded in a specific time section and describes a real process which has run in time. In our case it is working of the hydroelectric plant Dlouhé Stráně. Here there is a dynamic record scanned by a digital camera as a video. At the picture 1 there is mentioned preview of the video which describes working of one of turbines of the power station from the sight of the dispatcher controlling. Working is

animated, flow of water is symbolized by white balls and in video they move. The upper and the lower basin, turbines, distribution point, lead are mentioned in form of pictures and signs. Number data about working, necessary for controlling the station, are seen numeric and they change their value after a station working. Enclosure of the story is a short video that will be presented at the conference.

The Static Visualisation, Practical Examples

One of possibilities of a static visualisation is i.e. creation of a photo documentation of a specific object (system) and creation of a band of pictures that we can present chronologically behind them. In our case it is a system of the station Dlouhé Stráně. On the contrast of the dynamic visualisation which displays a time section, static visualisation creates an image about a complex view at specific equipment or object. For this sake it is necessary to have permission to take photographs in the object (power station) and make a photo-documentation of a high quality which can't always be managed. Pictures 2, 3, 4 and 5 present part of many photographs that are necessary for creation of the static visualisation of the object (power station).



Ryc. 2. Distribution point



Ryc. 3. Underground cavern of turbines

Utilization of Visualisation in the Process of Teaching

Visualisation in the process of teaching at all grades of schools means utilization of a modern technique in education. For creation of a background of visualisation it is, in practice, important to dispose of dimension of technological literacy that is described i.e. by Salomon. Than it is possible to demonstrate technological principles of the technical system by visualisation and make possible to realize ideas of the teacher in education process with respect to the aim of the lesson. If we can realize a material for visualisation (to process a digital record – video, photographs) and prepare them as a background for teaching, we can accede to verification in education. With using of modern technique (computers, data projectors) we can present materials after the chosen topic.

Possibilities of Creation Materials for Visualisation

As it was written in the story, visualisation is very modern activity that enriches teaching. Its preparation is, from the view of a teacher, more difficult, it lays higher calls to literacy.

Preparation and subscription of the dynamic visualisation

During defining of the dynamic visualisation we must respect in order to a time section of a specific situation was recorded. For this record it can be just tens of seconds – max. one minute. More time of recording is not suitable because the process repeats itself. In the demonstration of the dynamic visualisation on the example of working of the pumped storage hydroelectric plant Dlouhé Stráně there is possible to see that the digital record, of the length of tens of seconds, describes the principle of working of the power station. During its starting through the programme i.e. Media Player and with a teacher's comment, students understand how the power plant works and how it is controlled from the controlling dispatching point from the view of the dispatching control. The dynamic visualisation can be used in various special subjects where is possible to demonstrate various actions and principles. To create material that fulfils demands of the dynamic visualisation is not a big technical problem. It is important to find a suitable object where a short time section describes a principle or working of a specific appliance. From the view of electro energetic there are more possibilities of video records for the dynamic visualisation. I.e. working of the power plant, time run of disconnection of the lead by breaker and buffer, make and break of the transformer, chokes and other appliances. Such digital video records are possible to archive in PCs as little files and they are prepared as theme complexes for teaching.

Preparation of material of the static visualisation for teaching

The static visualisation is quite simpler than the dynamic one. In practice it means that during preparation for teaching we must have at disposal an area or a set of pictures that show specific object (i.e. power plant, distribution point). Than we can chronologically order these pictures and describe what is at them. For using it during teaching we can insert these pictures into the presentation programme – i.e. Power Point – with a suitable comment and we have prepared a material for teaching. Again it is possible to archive such material in PCs.

Conclusion

At present, when technique enables us to do digital records it is important to accept the fact and use it for enriching and modernisation of teaching. A digital record of the picture enables simple adaptation on conditions of the present teaching process. In the story there is mentioned utilisation of a digital record during teaching. It is working of the pumped storage hydroelectric plant Dlouhé Stráně. Utilisation of such record during education process is big, because students gain an idea how such action has run (working of the power plant from the view of the dispatching control). These video records are possible to present through the programme of Media Player which is a part of Windows. In the end it is possible to say that utilisation of the dynamic and the static visualisation leads to enriching teaching and to its modernisation.



Ryc. 4. Leading out of the capacity from the station



Ryc. 5. Metal-enclosed distribution board

Literature

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Wizualizacja pracy hydroelektrowni szczytowo-pompowej Dlouhe Strane i jej zastosowania edukacyjne

Streszczenie

Wizualizacja jest nowoczesną tendencją we współczesnych systemach kontroli i monitoringu. W artykule zaprezentowano przykład użycia wizualizacji w przedstawieniu działania czeskiej hydroelektrowni szczytowo-pompowej Dlouhe Strane. W tym celu przygotowano nagranie wideo z systemu kontroli. Wizualizacja działania elektrowni oparta jest również na dokumentacji fotograficznej. W artykule wskazano, które materiały mogą zostać wykorzystane w wizualizacji, oraz zademonstrowano ich użycie na konkretnym przykładzie zaczerpniętym z praktyki.

Słowa kluczowe: wizualizacja, pojemność elektrowni, centrum dyspozytorskie, rejestracja wideo, zbiornik górny, zbiornik dolny