VdS Conference

- **„Fire protection systems”**

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Fire protection in heavy industry The example power plants

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Safety buildings. Safety people. Safety business.

Requirements of Polish law for heavy industry

Polish regulations, in case of industry, define requirements only for fuels and gas basis.

In case of huge plants, among others power plants, the regulations cover only following matters :

1) Fire roads,
2) Firefighting water supply (only in basic scope),
3) Outdoor hydrants,
4) Indoor hydrants (useful only for multistoried buildings),
5) Protection against explosion (in case of hazardous areas classification, but lack requirements for protection against explosion).

Lack of significant requirements for fire protection of industry buildings and installations determines designers and experts to engineering approach in work and application of above law requirements as initial minimum.

Process of power plants project execution

The execution period of typical power plants projects, counted from start of main contractor selection to plant hand over for normal operation, it amounts 3-4 years in case of gas and biomass blocks to 6-8 years in case of big coal fired blocks. This period develops till 10-12 years in case of nuclear power plants.

The execution process includes following stages:

1) **Main contractor selection (RFQ and preliminary civil building permit design preparation necessary for banks permission for project financing)** – civil building permit design contains only very basic information about technology and fire protection.
2) **Basic design** – includes whole technology data and presentation of technical solutions, fire protection matters as well – the presentation contains fire passive and active protection technical solutions selection with descriptions, diagrams and technical specifications.
3) **The first revision of civil building permit design** – the law basis for first stage of site works.

Process of power plants project execution

4) **Detail design** – it is real technical documentation for site works.
5) **Further revisions of civil building permit design** – the quantity depends on changes capacity occurred during execution.
6) **Erection and assembly of buildings and installations**.
7) **Start-up** – before it all fire protection systems shall be finished and tested – the time period of start-up amounts 3-9 months.
8) **Commissioning and hand over for normal operation.**

From fire protection systems design and supply point of view the most important stages in industry and power plants projects are :

1) **RFQ (Request For Quotation).**
2) **Basic design.**
3) **Detail design.**
4) **Erection with commissioning.**

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RFQ

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RFQ – lack of details means troubles

The most investors of big industry projects, among others power plants, are public companies and big international corporations.

The majority of projects are ordered as „turn-key" projects with flat rate payment.

RFQ is an attachment to a contract.

Above mentioned should determines the level of details of RFQ requirements for fire protection, which significantly exceeds expressions like „**According to law**" or „**Fixed extinguishing system**" and also it should defines following data:

1) Selection of passive and active fire protection systems.
2) Standards of supply – it means design, equipment selection, commissioning rules, contractor and equipment certification. It should contains documentation review and commissioning on site as well. In such important investments the designing „**based on standard**" should be not enough and the designing „**according to standard**" shall be applied.

There is needed to note, that changes to contract in such projects are very difficult and laborious process and willingly omitted by all sides partially at fire protection expense.

RFQ in fire protection cases shall be prepared by experienced fire protection expert.

RFQ – examples of mistakes

The suggested approach to RFQ in case of fire protection is rarely common practice, what can cause following results:

1) Lack of signed insurance policy in accordance with contract agreed with main contractor.
2) Expression „fixed extinguishing system" or „extinguishing installation" without necessary installation details – it causes to possibility of sprinklers system supply (rarely applied in industry) instead water spray or mist system.
3) Expression „according to law" – it leads to lack of necessary fire protection measures, because of lack of law requirements in such case.
4) Problems with supply of some technical solutions – there is no possibility of supply certified fire alarm system to supervise one floor building high more than 25 m, especially, that 25 m distance is exceeded from fire source to smoke or heat detector be located under roof…

Basic design

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Basic design – scope

The purpose of basic design is a presentation of technological details and in case of fire protection work out of:

1) **Fire protection design concept includes:**
   a) Hazards identification with fire development scenario for individual buildings and installations.
   b) Passive and active fire protection technical solutions with detail presentation in process flow, P&ID diagrams, visual drawings.
   c) Fire scenario (algorithm of action of technical systems and rescue services after fire detection).
   d) Risk assessment.

The design concept shall be prepared as one document or few with one leading document.

The documents shall be prepared by experienced fire protection experts and agreed with specialists from other building and technological branches.

Basic design – scope

2) **Hazardous areas study includes**:
   a) Hazards identification.
   b) Technical fire protection systems selection and suggestions of potential changes in technology.
   c) Risk assessment.
   d) Drawings presentation.
   e) Assumptions for equipment selection and for normal operation period.

The study shall be prepared by experienced fire protection expert or explosion protection expert and agreed with technology team.

Basic design documents (fire protection scope) shall be agreed with insurer.

Basic design shall be summarized by technical specifications for protection systems with strictly defined standard of design, supply and commissioning.

Basic design – agreements

Basic design of fire protection for big plants shall be done by team of specialists under fire protection expert direction with support of:

1) Technological team,
2) Architects, building structure engineers and specialists of other building branches,
3) EHS specialists,
4) Investor,
5) National Fire Service,
6) Science offices (VdS, ITB, GIG, SGSP…),
7) Insurer.

Lack of above agreements in future can cause mistakes in technical documentation and problems during commissioning.

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Basic design – deviations

In each country the law regulations are not suited to heavy industry. Commonly during designing of power plants is necessity of receiving of approvals for deviations from law regulations necessary to build expected building without problems during commissioning and normal operation.

The frequent examples are:

1) Fire zones bigger the normative.
2) Lack of firefighting water tanks in buildings higher than 25 m.
3) Lack of indoor hydrants or hydrant valves on each floor of buildings higher than 25 m …

Above mentioned deviations are submitted and agreed at individual stages of civil permit design revisions. However, because of big time-consuming by such process the technical documentation should be agreed with National Fire Service during permit design stage.

Basic design – standarization

In Poland in all industry branches, in power plants as well, is a deficit of:

1) Modern/new reference projects (last 15 years),
2) Designers and experts (specialists, certified experts), which have an significant experience related to similar new projects (last 15 years),
3) Contractors, which have executed similar projects (last 15 years),
4) Inspectors and certified experts, which have huge experience in site supervision and commissioning of fire protection systems.

Consider above at this stage is necessary specify design and supply standards for given systems and selection of science and technical office, which assure proper level of supervision on each realization period. **In Poland, at this moment, it is necessary condition to success, but in world common practice**.

Basic design – examples of mistakes

The oftenest mistakes caused during basic engineering in fire protection matters are:

1) **Lack of specified technical standards of supply or lack of precision scope of given standard application** – design and supply „**base on standard**", but not „**according to the standard**" is a nightmare of investments realized in Poland.
2) **Lack of fire and explosion hazards identification** – details documentation authors are specialists as well and basing on too general data they could make a mistake in equipment selection and/or copy of mistakes are made in assumptions.
3) **Lack of precision algorithm of fire protection systems working, they mutual connections and connections with technological or building systems** – the results of it are lack of enough coordination during assembly and set working and additionally lack of expected system operation.

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Detail documentation

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Detail documentation – coordination

Coordination in fire protection is the most expensive part of management process of industry investments:

- **It requires leaders with engineering knowledge and experience.**
- **There is necessary external experienced experts (persons or/and offices)**.

Often, the leaders rules fulfill engineers with small experience, more than once coming from other technical discipline based on some trainings and company experience. Other such function fulfill engineers with huge site experience without skills related to new technology and new investments.

The second type of experts almost not occur in plants investments, because of economy and (unfortunately) of deficit of them in Polish market. A few players are focused on technical and law assumptions or equipment certification.

Detail documentation – standardization

Detail documentation is the one document making the base for assembly/erection, set working and using of fire protection systems, measures.

In case of plants the conformity of detail documentation wit given standard is more important than in case of commercial buildings, because of small numbers or lack of reference objects.

Additionally, technical standard assure the knowledge of proper commissioning and operation of installation.

If the designer decides to design „based on some standard" or according to self knowledge he or she takes significantly responsibility. If he or she will not work out proper quality commissioning instruction and OMM the responsibility will be completely on his or her side.

Detail documentation– examples of mistakes

Unfortunately, detail documentation contains the biggest number of mistakes. The oftenest are:

- **Lack of coordination between other branches** – e.g. smoke removal with structures or extinguishing, extinguishing with equipment arrangement…
- **Improper fire detectors selection or type of extinguishing system** – heat detectors supervise cable routes, smoke detectors supervise areas with huge air circulation, sprinklers protect coal handling…
- **Improper arrangement of detectors, nozzles or alarm sounders**…
- **Improper anchoring system**,
- **Improper or not complete OMMs**,
- **Lack of professional commissioning instructions**.
- **Very pure instructions of operation**.
- **Mixing of technical standards requirements** – e.g. one for mechanical part and other for automatic part.

Site execution

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Site execution – works division

The best solution is order given fire protection system as complete set (mechanical and electrical parts) to one contractor. The order scope should contains:

1) **Detail documentation** – there is possible to order separately, nevertheless the responsibility of proper system operation will be divided into two participants.
2) **Supply and assembly** – the supply could be excluded (theoretically).
3) **Set working and commissioning**.
4) **Employer staff training**.

The supply of elements in green realized by one supplier, as a minimum scope, gives the biggest chance for success and clearly defines the responsibility of effective system operation.

The division of the system into two or more parts is not acceptable, because a coordination of whole system is very difficult, what decreases system reliability.

Site execution – who should be a contractor

The simplest answer is the order to company possesses proper quality certification. Polish market contains only voluntary certification realized mainly by SITP and CNBOP, VdS.

SITP and CNBOP do not provides of audits during assembly and commissioning and last certification was realized by them on 2011. The most certificates issued by them is not valid. However this activity should be appreciated as pioneering among other Polish technical offices related to fire protection.

VdS, as only one assure complete supervision of fire protection systems, it means design documentation, assembly, commissioning, normal operation and equipment certification based on well recognized self technical standards.

The order supply of fire protection system to company certified by VdS make future negotiations wit insurers easier and in case of fire outbreak discussion with institutions connected with judiciary as well.

In Poland there was not the spectacular trial of loses are caused by fire or lack of object hand-over for normal operation, but if we look on „old" EU countries it is open question and will occur.

Site execution – supervision

Polish law Regulator recognizes, that in case of site supervision of fire protection systems the best solution is providing it by civil certified inspectors.

In case of above mentioned it will be realized by:

1) Fire alarm system, gases detection and automatics of fire systems will be approved by **electrical engineers**.
2) Extinguishing systems (gas and water) and smoke removal systems will be approved by **sanitary and HVAC engineer**.
3) Passive fire protection systems will be approved by **civil engineer**.

In Poland, there is no any postgraduate courses and other courses (mandatory) for certified site inspectors dedicated for fire protection cases, what causes various quality of site inspectors approving fire protection systems for normal operation. Usually this process is realized superficially and partially accidentally.

Site execution– examples of mistakes

The oftenest mistakes are:

1) Lack of verification of qualification of site managers of teams supply fire protection systems.
2) Lack of enough supervision of anchoring quality.
3) Lack of enough supervision of assembled components, it means if these are in accordance with detail documentation, e.g. pipes thickness or detectors or nozzles types.
4) Lack of enough supervision of fading works, e.g. in case of passive protection.
5) Lack of necessary supervision on thickness of intumescent paints…

Commissioning

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Commissioning – proceeding rules

First of all the commissioning should be defined according to technical standard applied to given fire protection system.

Additionally Polish law expects series requirements, which have to be fulfilled.

Unfortunately, proper knowledge and experience are necessary to execute above mentioned activities, what is made difficult significantly by various types and huge quantity of systems.

Furthermore, a commissioning is often made harder by lack of professional commissioning procedures/instructions attached to technical documentation, what in case of plants with various hazards, is really essential.

There is unlikely, that site inspector, which surveys heating and ventilation systems is able to professional commissioning of sophisticated fog or gas systems or protecting against smoke. This inspector is responsible of explosion suppression systems as well.

Commissioning – proceeding rules

There is unlikely, that site inspector, which surveys electrical or earthling installations is able to check of properness operation of fire alarm system, which additionally influences on operation of several dozen other systems, what in huge plants is commonly.

Taking into consideration above noted, they focus especially on formal documents and „organoleptic" tests, it means observation if system works, e.g. extinguishing system is actuated after fire detection by fire alarm system, **but if effective … it was shown by recent fire of oil cooled transformer in Rybnik Power Plant, which was equipped with water spray system, which assure nothing protection**, what was proved „in real".

The most effective way for commissioning of fire protection is order it to external expert / well recognized institution, which by self knowledge, experience and authority confirms, that given installation is proper working.

There is necessary to note, that these systems not working permanently, so in which way there is possible to convince the user, that his plant and business is protected properly.

Commissioning – examples of mistakes

The oftenest mistakes during commissioning of fire protection are:

- Lack of verification of properness of software and systems control units operation.
- Little quantity of tests realized according to technical standard or commissioning procedures properly.
- Little tests realized according to fire scenario individually prepared.
- Lack of full knowledge about scope of contents (required by law) of OMMs and certification documents of equipment.
- Lack of knowledge about required by regulations scope of content of statements of conformity with law regulations and technical standards, e.g. related to ATEX.
- Frequent lack of proper cooperation with insurers, National Fire Service and other institution, which will be survey the object in the future.

Summarize

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Summarize

Big plants, among others power plants, requires individual approach.

Currently, there is executed the process of plants modernizations after huge interruption, what causes small quantity of reference objects.

In Poland is generation hole caused by lack of investments and civilization jump.

An investment related to fire protection executed properly requires supervision and coordination realized by one person/institution during whole investment cycle.

The investment shall be supervised by external experts (persons or institutions).

Strictly application of technical standards from designing to commissioning.

The supervision under design process, assembly and commissioning by notified body like VdS as guarantor of good practice.

Summarize

Costs and losses:

- Coal fired power block about. 900 MW – **worth about. 5-6,5 billion PLN**.
- The worth of all passive and active fire protection, which shall be applied in a/m power block – **worth about. 17-22 million. PLN**.
- The worth of professional engineering and experts service related to fire protection in such case – **worth about. 400-600 thousands PLN**.
- Explosion in “Dolna Odra” Power Plant – **2 casualties**.
- Approximate losses (directly and indirectly) in “Turow” Power Plant caused by explosion in 2012 r. – **worth about. 50 million. PLN.**
- Approximate worth of oil transformer (only directed costs), which burned down in 2014 – **worth about. 2-3 million. PLN**.

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Thank you for your attention

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