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THE IMPLICATIONS OF THE CONFIGURATION MANAGEMENT ON THE SHIP ON-BOARD WATER DISTILLATION INSTALLATIONS

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Abstract: *The formal change control method within a project, known as the configuration management, is intended to allow changes on all engineering levels. Practically, the term of configuration management itself means the application of management methods in order to maintain the coherence of the systems and their components, when certain parts of the systems are affected by various changes. In other words, it is the identification method of the configuration of a system at given time intervals, aiming at systematically controlling the changes incurred by such configuration and keeping its integrity, besides the possibility to monitor this configuration during the entire lifetime of the respective system.*
In this work, the advantages of applying the configuration method of the on-board water distillation installation were tracked, this installation being used for removing the salt from seawater, in case of replacing the evaporator-heating agent.

Key words: *the configuration management, the configuration control, the configuration status records, the configuration auditing, the engineering elements and the configuration elements.*

1. INTRODUCTION

The intention of this paper is to present the advantages of configuration management in ship on-board water distillation installation.

The configuration management is a formal change control method within a project, its main purpose being to allow changes at every design level. It is used during the entire lifetime of a system and its appliance starts immediately when the first agreed document is issued that will be used as a base for the emerging development activity.

All the components that are produced during the development stage of a project form a configuration of identifiable elements that can only be changed by a systematic and thoroughly documented process. The constituent elements may be sets of requirements, specifications, user manuals, technical drawing for the various components, anything that can be identified and contributes to the achievement of the ultimate result of a project. The configuration designates all the components of the system and the inter-relations existing among them [1]. The configuration elements and the engineering elements are presented in Fig.1.

A key element of the configuration management is the need to know the elements of a system's configuration that are dependent on a given element. When such dependencies are known, the extent of the effects generated by the change of any element within the configuration can be defined.

Any configuration of a system increases with the development of new constituent elements. At the beginning of the system development, the configuration consists of the documents determining the extent of the project, namely the specifications referring to the requirements of the system. Once they are authorized,

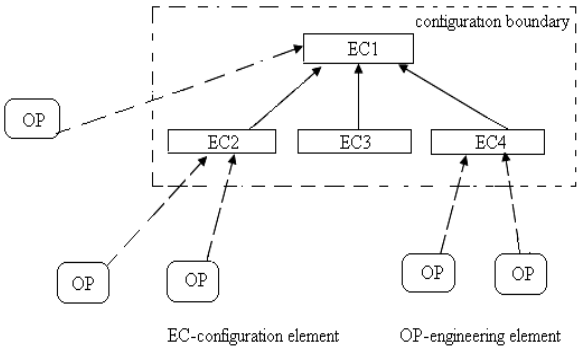

Fig. 1. The configuration elements and the engineering elements.

such documents become part of the configuration and are subject to some standard change control procedures.

The configuration does not include such components that are still under development, called engineering elements, because such items may change from one day to another, since they have not reached a sufficient maturity level to require the control of the changes. Unlike the engineering items, the configuration elements that have been identified as such within a system and all the evolutions related to them are documented, so that any change of these should be made only based on an authorization by the qualified persons. Consequently, the project engineer will be able to operate any change he/she considers to be necessary on the engineering items and will keep personal records of the changes, which will show no interest to anyone else [2].

A useful element within the configuration management is represented by the interfacing conventions (specifications), mutually agreed among the project engineers, defined as configuration elements. The advantage

of defining such interfacing specifications as elements within a system is the fact that they can only be changed or supplemented with the approval of the project engineers who have participated in the development of the respective interfacing elements. These project engineers will be able to further work, on an individual basis, on the following elements that are dependant on the previous elements.

When estimating the impact of a change in engineering, the main concern is to determine its effect on the element depending on it. Should it result that one of such elements also needs to be changed; the effect extends on all the elements depending on the latter, and so on. The most favourable form of engineering, from the change control viewpoint, is the one that is reducing the number of interfaces among the elements to a minimum.

Czewinski and Samaras (1971) are the founders of the configuration method while Babich (1986), Bryan and his collaborators apply configuration management in production and software application fields. Starting from the management deficiencies from American defense industry, they present the reasons for which the government agencies insisted on using the configuration management.

2. THE CONFIGURATION MANAGEMENT MECHANISM

The main elements of the configuration management method are: the configuration identification, the configuration control, the configuration status recording and the configuration auditing [3].

The configuration identification defines in a unique way all of one's configuration elements. Therefore, once the configuration structure and control unit were designated, each element can be identified, in a manner that will make it unique inside the analysed system. The element identified this way is recorded afterwards in a record. This job of recording the name of each element is called the configuration identification. Because the identification code given to each element is unique and constant in any situation, this will allow that the respective element to be used by many persons for different tasks inside the system. Usually, to each identified element it corresponds a name and eventually a version number.

All the configuration elements should be than physically labelled in order to be clear which their identity is. In other words, each element receives a label that confirms that the respective physical element is recorded in the configuration register. These labels are applied both to the documents and to real objects. In case of real objects, the identification labels are written directly on them during the manufacturing phase. In this way, the labels identify the respective objects and associate them in an undisputed way with the recorded elements from the configuration register, taking care that these labels to be protected, in order not to do any modification without proper authorization.

In case that it is necessary to design many parallel configurations, they are called choices. These choices are available in the same time.

Another way of reaching different choices is when an element is improved or modified. The new version replaces the existing one, but, if the old element is still used, its configuration should also be kept.

After all the configuration elements were identified, they should be protected against both unauthorized changes and accidental damaging. The usual way to protect the configuration elements is by building-up an archive or a physical warehouse for the configuration elements.

In case of error occurrence to one configuration element which is to be corrected, it is mandatory that the correction proposal to be done public and the change itself to be recorded in registers. In this way, all the designers who are using the respective configuration element will know what correction should be performed and will approve the required change. If small corrections are performed without general consent, it is impossible to reach a strong reference level in defining the respective component.

A second element of the configuration management method is the configuration control. In order to be sure that the configuration control system is working as desired, it is necessary to establish some procedures. Based on them, it will be known for sure that, no change will be performed without evaluating in advance its impact by the ones that can be affected by it or to obtain the approval from the authorized persons. Therefore, there are used individual elements, controllers, in the configuration management, to authorize effectively all the changes performed on one element.

For a strict configuration control a configuration administrator is designated, to whom there are addressed all the change requests and who transmit them forward to the controller who is in charge with the respective matter. Taking into account the fact that the change impact should be determined before the implementation decision, all the important events from this process are recoded and made public.

The best way to evaluate the change impact on one element is to address to the responsible designer of that element who detains detailed information on the respective field.

Another major element is choosing the moment when the control is applied to one component from the analysed system. If the control is applied too fast, the element development is slowed down because of the restrictions regarding change performing [4].

If the control is applied too late, this can lead to confusion at the interfaces level among components. Therefore, it should be considered the right time when to apply the changes control on one component, taking into account the scale of the respective changes and the requests imposed by the other designers.

Any change request of one element from the analysed configuration can also determine changes to other elements. In this case, the configuration dependencies chart can be used to stimulate the affected elements' designers to identify the effects of the resultant changes as well as the costs and the performance.

In order to decide if a change should be performed or not, it is necessary to: estimate the benefices of performing the change as well as the consequences that might occur if the change is not performed, estimate and evaluate how will be affected the general configuration and

which will be its possible effects, estimate what should be changed as a result of the initial change and which are the effects on all levels in the designing hierarchy, as well as which could be the consequences on costs and project building deadlines.

A choice considered ideal, in this change control mechanism is that the development process of the analysed system to be divided into phases that will mark the moments when the control versions should be updated. In this way, all the involved designers will have access to the periodically updated versions.

Another main element of the configuration management is the configuration status recording [5].

Its purpose is to record all the events happened in the system during the development phase, in order to compare the real evolution with development plan and to create a mechanism of change tracking. In this way it can be known in every moment, which is the actual status of the system development and which way lead to this estate.

Among the recordings that can be stored in the database there are: creating new configuration elements, together with the authority in the name of which the change control was performed, the change requests, the change approval/the rejection decisions, the change notifications issued after elements modification, stored elements updates of the system itself. Using these data, the status recording system can generate reports regarding the status and time evolution of each configuration element.

The configuration auditing is the final element of the configuration management method. Its purpose is to check if no matter the changes that affected the request and their design, the elements are produced as per current specifications and if all the used quality-assuring procedures were performed at a satisfactory level. Checking if the manufacturing norms of all the elements are compliant with the resulted specification from the design phase performs this. In turn, these specifications are checked in advance to verify their compliance with the design requests. In order to make the auditing possible, it is necessary to identify all the produced elements and to record all the activities performed to produce them.

3. APPLYING THE CONFIGURATION MANAGEMENT ON SHIP ON-BOARD WATER DISTILLATION INSTALLATIONS

The sea ships have the seawater distillation installations to reduce water salinity. This water is for crew consumption. The water distillation installation is presented in Fig. 2.

The working principle consists in: the vessel with evaporator and condenser is put under vacuum by means of a seawater-driven ejector pump. The absolute pressure must lie at approx. 0.1 bars. At this pressure, seawater will evaporate already at approx. 40˚ C.

Part of the admitted seawater boils when getting into contact with the hot plates and leaves the evaporator as steam through the open side of the plate pack. The remaining quantity of seawater now containing a higher salt concentration (brine) is exhausted by the ejector and led overboard.

The steam from the evaporator passes through a demister to the condenser. The condenser is built like the evaporator with an open side at the top towards the vacuum tank; the opposite side is totally closed. On the closed side, cold seawater is circulated. When the steam gets into contact with the cold plates, it will condense into fresh water. Normally, the condenser is connected to the seawater cooling system of the ship-possibly to fresh water from the central cooling system of the ship.

The fresh water is pumped to the fresh-water tanks of the ship thereby passing a sensor that is connected to a brine gauge.

In the most of hierarchical project building, from top to bottom, the upper level design is performed first, and then divided in lower levels that in their turn are subdivided also. This designing and building method is applied to most of the objects or physical systems. In each sub-division on each level of this hierarchy, the building elements are identified, their design and implementation being the task of the individual designers.

In the project of a ship on-board water distillation installation, the designing team consists of two chief designers, one dealing with heat exchangers (evaporator, condenser, water cooler) plus water supply system and the other of the shell and instrumentation. The two designers are drawing the installation layout project, which will stick with the identified requests of the projects, becoming the second configuration element. The configuration element hierarchy can be drawn as in Fig.3.

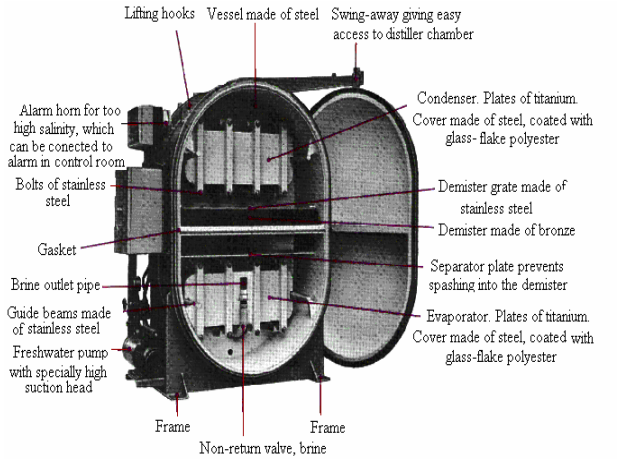

Fig. 2. The main elements of water distillation plant.

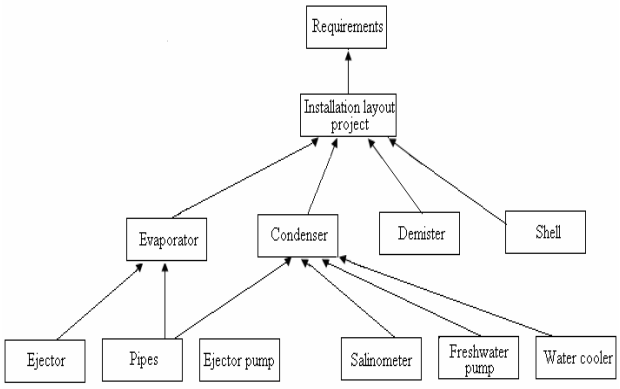

Fig. 3. The configuration element hierarchy of water distillation installation.

In the configuration upper part are the installation requests: the purpose for which is used on-board (obtaining distilled water), the installation capacity and salinity. On the next configuration-level occurs the layout project.

In the presented configuration, the arrow that starts from layout project to requests, points in the fact that the layout is dependent on the established requests. In other words any request change can have in impact on the layout project. On the next configuration level, occur the main installation components (the evaporator, the condenser, the demister and the shell) and on the other level are presented the other components that depends on the main components (the ejector, the pipes, the freshwater pump, the ejector pump, the brine gauge, the water cooler), built in the designing process. Each of these configuration elements represents the configuration elements identified and protected against changes.

While the installation components design is going further, in the database are recorded also other configuration elements as shell drawing, pipes, pump, motor etc. when introducing each new element in the database, the place where the drawing is kept is recorded, and the recording is performed so that nothing can be changed to the drawing without the necessary authorization.

After the configuration identification follows its control, which implies evaluation, coordination and systematically examination for approval or rejection (as is the case) of the proposed changes for the configuration elements. For each configuration element, there is a person on behalf of the technological department responsible for examining the requested changes.

Let us assume that the designer requests the evaporator heat exchanger surface and consequently, its dimensions increase. The respective change is justified by the designer considering it a better choice for ships. The requested change for the evaporator will affect the installation layout project and this is brought into the entire designing team attention.

The change control process includes the next steps:

• the designer, who requests the change, sends the change request to the designated configuration administrator;

• administrator is recording the request, checks in the database what other elements are directly dependant on the evaporator for which the request is done and sends it to the respective element controller (the person who checks the evaporator project);

• element controller requests to the evaluator on which competency belongs to, to determine the change feasibility and impact;

• evaluator consults the specialists and records their opinions (the designer who drawn the layout plan);

• element controller approves or rejects the request;

• administrator is recording the decision and informs the involved persons;

• change is implemented, which will be a new evaporator building design and this fact is reported to the configuration administrator;

• new evaporator version is authorized;

• it is recorded the new evaporator status making it public to the involved designers.

Having a clear record of all the configuration elements status, starting with the recording of all the configuration elements description, together with the change proposal situation of the components and the implementation status of these changes, periodical reports are issued that will inform in any moment the persons involved in the installation design on each element time status and evolution. In this way it will be known what was achieved till the report time in all of the project fields. A comparison can be performed afterwards between the current real status and the plans for each designing field used for further corrections.

The last stage of the configuration management points to configuration audit. This step implies the checking performed by configuration auditor of the way on which the configuration management system works and if its used properly. Practically, the configuration auditor informs himself on the following aspects: if there is a clear record of all the configuration elements, identified without doubts as well as of the change requests with each result, if all the changes were authorized, if there is a prove of the detailed sub-projects check, regarding their compliance with the layouts, if the interfaces were checked between the configuration elements not to have discrepancies among different project components, as well as if specifications were established for the tests that have to be performed before the project approval.

4. CONCLUSIONS

In this essay we tried to explain, starting from the configuration management concept and its mechanisms, the way in which the configuration management is applied, for instance to an on-board water distillation installation for seawater and its advantages.

When designing, one or more elements need to be replaced almost every time and this will have a further influence on other elements dependent on the first ones.

By applying the configuration management all the changes can be controlled that can take place on configuration, the configuration diagram indicating what elements depend upon each other, so that if one change was performed to a certain element which will be the other elements that can be modified.

This method allows designers to improve change proposals and to report the system status.

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