Coding in Krško NPP Corrective Action Program

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ABSTRACT

Corrective action program in nuclear power plant (NPP) facilities provides systematic approach in treatment and consideration of domestic and industry operating experience with the aim of preventing events or repeat events. Purpose of Corrective action program is to improve nuclear safety, industrial safety, and reliability of the NPPs. In Krško (NPP) a computer environment was developed which enables opening of corrective action requests which are then processed, tracked, and analysed if required. From 3000 and up to 4000 corrective action requests are written per year. This represents a big database in which more than 100.000 requests were collected through the years. To manage such vast number of requests and to make this database useful and user-friendly as much as possible, coding of the requests is required.

Coding is a process of assigning codes (numbers), words, or phrases that identify to which topics or issues portions of the data refer, and organizing the data in a way that is useful for further analysis [1]. Prerequisite for getting relevant results from corrective action program database is to put in good and relevant data and to code this data with consistency and in accordance with prescribed rules. Consistency in coding can only be achieved if coding is done by as low number of coders as possible.

Coding of corrective action requests is necessary for successful trending of safety problems, minor events, recognizing adverse trends and addressing Common Cause Analysis. It allows various data browsing as well as graphical presentation. Not all requests are suitable for coding. In Krško NPP we created a list of types of requests that we do not code. In this list there are requests not related to process of the plant, requests that were rejected by screening committee, requests for some small repairs in the workshop, installation or removal of some smaller equipment or tools (Computer equipment, telephones ect.). There are various groups of codes adopted in Krško NPP Corrective action program and not all groups of codes are applied for all requests. Degree of coding depends on corrective action request classification and on the degree of analysis applied to the request. Most basic coding is based on direct cause and consequence coding. More extensive coding also include department, causal factor, causal factor type and significance level. There is also possibility of marking repeat events, near misses and source of the requests.

Keywords: *Coding, Corrective action request, Direct cause, Causal factor*

1 INTRODUCTION

Quality Assurance at the Krško NPP follows the American Code of Federal Regulations as well as Slovenian regulations. 10 CFR part 50, Appendix B, Criterion XVI requires the following: "*Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance 's are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken shall be documented and reported to appropriate levels of management."*

Based on the above and the requirements of the Slovenian radiation protection legislation (ZVISJV-1), Krško NPP has developed and applied an internal Corrective Action Program. The program facilitates a systematic approach to the treatment and consideration of domestic and industry operating experience with the aim of preventing events from occurring or recurring. Krško NPP uses a computer environment which was developed to enable writing, processing, tracking and, if required, analyses of corrective action requests. Between 3,000 and 4,000 corrective action requests are written per year. This number varies mainly due to the increased number of activities during the outage periods, the number and size of the projects carried out at the plant and the issued important documents in the industry.

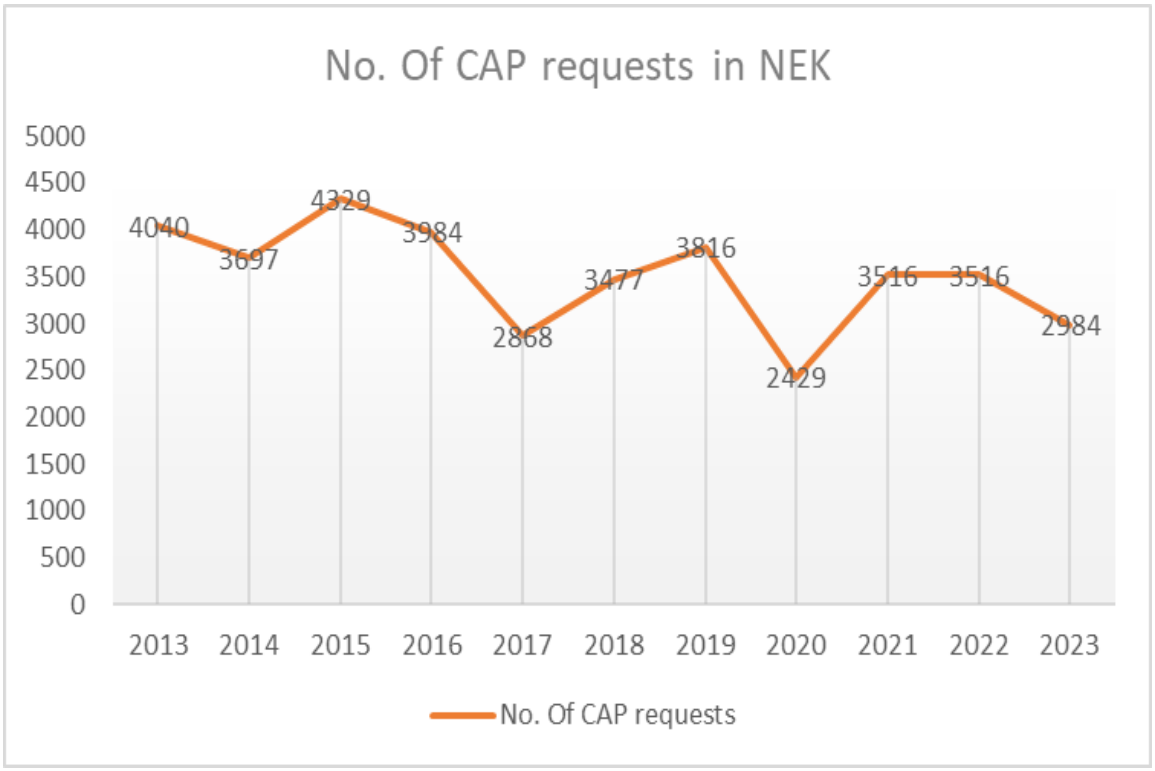

Figure 1: No. of written CAP requests during last 10 years

From the beginning of its use, more than 100,000 requests have been collected and stored in an extensive database. To manage such vast number of requests and to make this database useful and as user-friendly as possible, efficient coding of these requests is required.

2 CODING

Coding is a process of assigning codes (numbers), words, or phrases that identify to which topics or issues portions of the data refer, and organizing the data in a way that is useful for further analysis [1]. In Krško NPP, corrective action program coding is provided in various stages. For well-defined requests referring to some common deviations with low importance and no safety influence, coding can be provided in early stages of the CAP request. For requests with high importance and influence on safety, coding is provided later when the repair is done, and additional information is provided or after analysis is provided and approved.

2.1 Structure of corrective action program

To understand the coding process of Krško NPP Corrective Action Program, we must first have a look at the CAP flowchart.

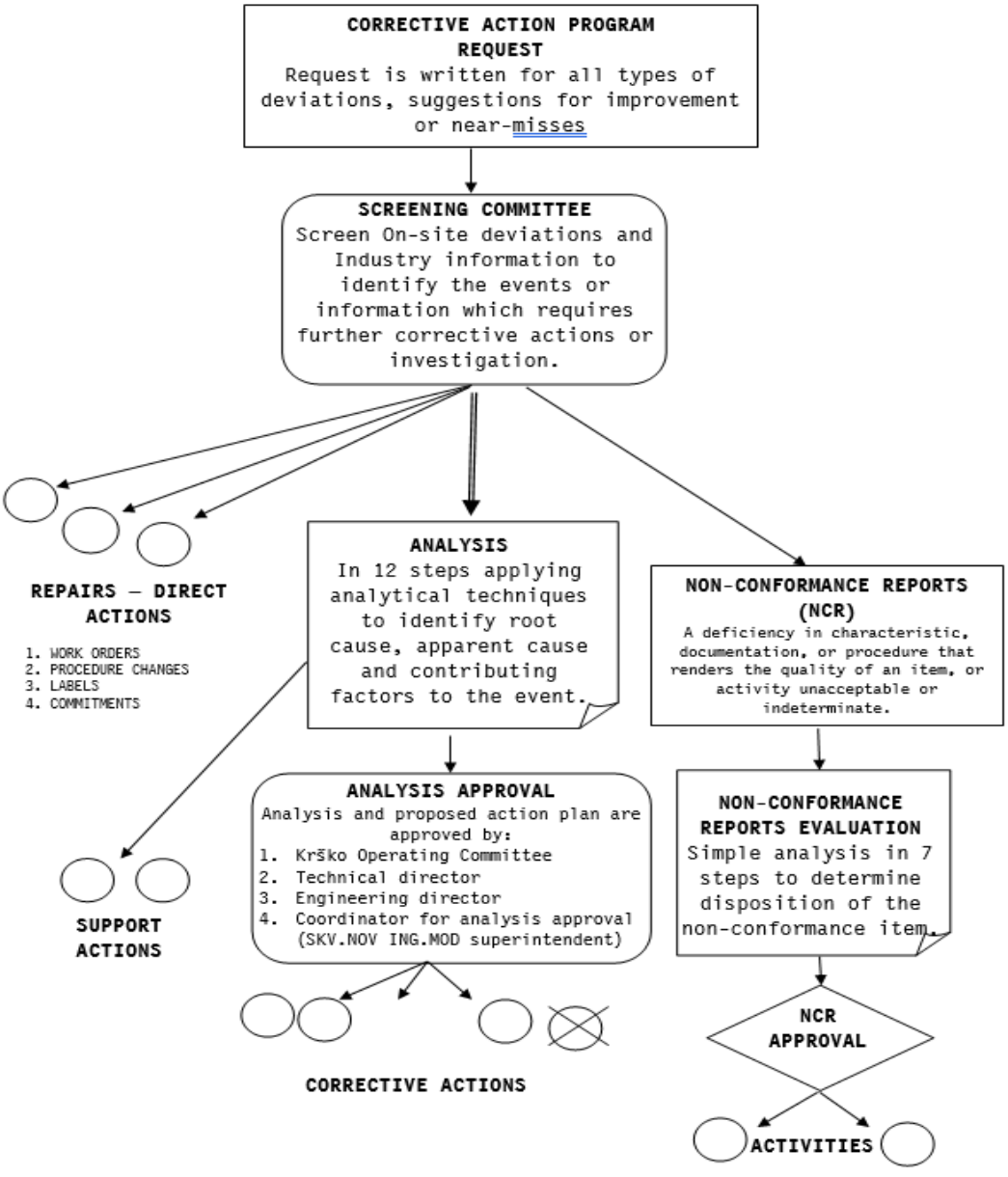

Figure 2: Simplified CAP flow chart

2.2 CAP request form

By filling-in the CAP request form, the author already initiates some basic coding by selecting options in fields like Safety related, Near miss, and System. Some fields are filled in automatically when equipment is selected from the Master Equipment Component List (MECL) data base.

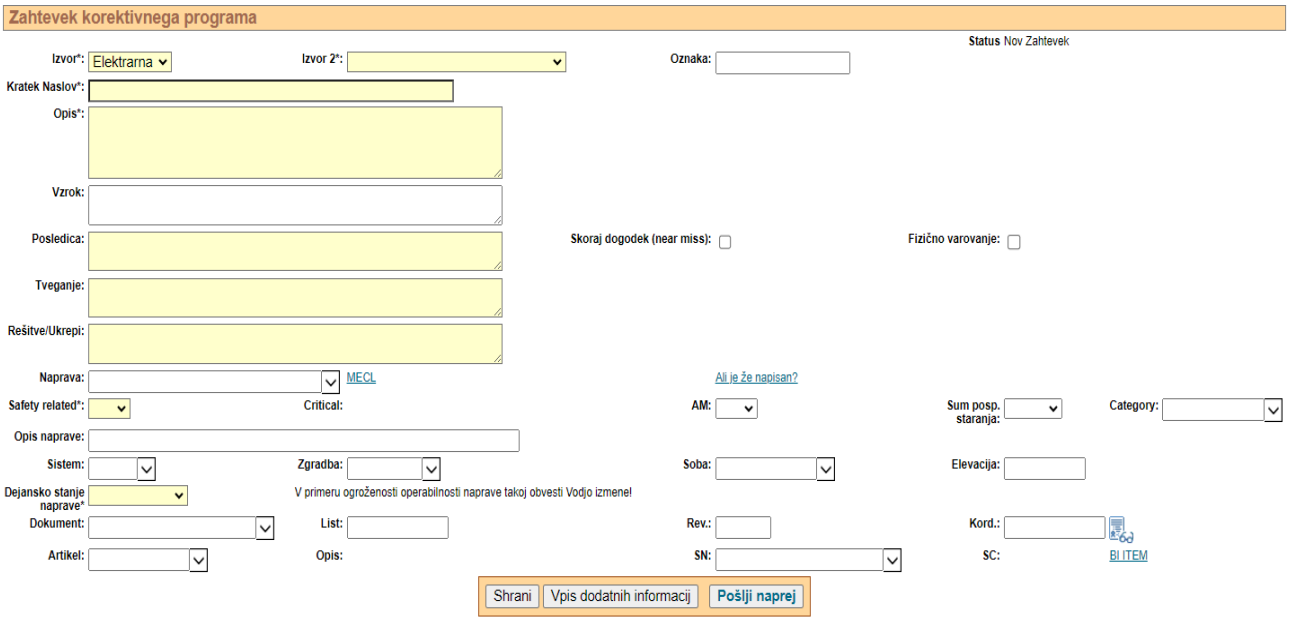

Figure 3: CAP Request form

This coding provides filters for the search engine and enables searching for certain request types.
Parameters that can be used for browsing the Corrective Action Program database consist of:

1. Time frame of the events
2. Reactivity management event
3. Word searches by title/description
4. Affected Equipment/system
5. Safe or reliable operation
6. Regulatory requirements
7. Reworks
8. Repeated events
9. Project (on-line operation/forced outage/outage) …

Additional codes are assigned to CAP requests by dedicated coders, and they are selected throughout different steps of processing a CAP request. and can be provided or corrected by dedicated coders at any time by using the coding page of the Corrective Action Program.

2.3 Coding page

Access to the coding page is granted only to the dedicated coders from the Independent Safety Engineering Group and they perform the final coding of the CAP requests. This coding is only provided for requests related to the technological processes of the plant. There is a list of 21 instances when coding is not required. The coding of requests suitable for coding is guided by a specific set of rules. Correct and valid data must be provided in the CAP request form, in the direct actions feedback and in the analysis to enable the assignment of correct codes from the code lists.

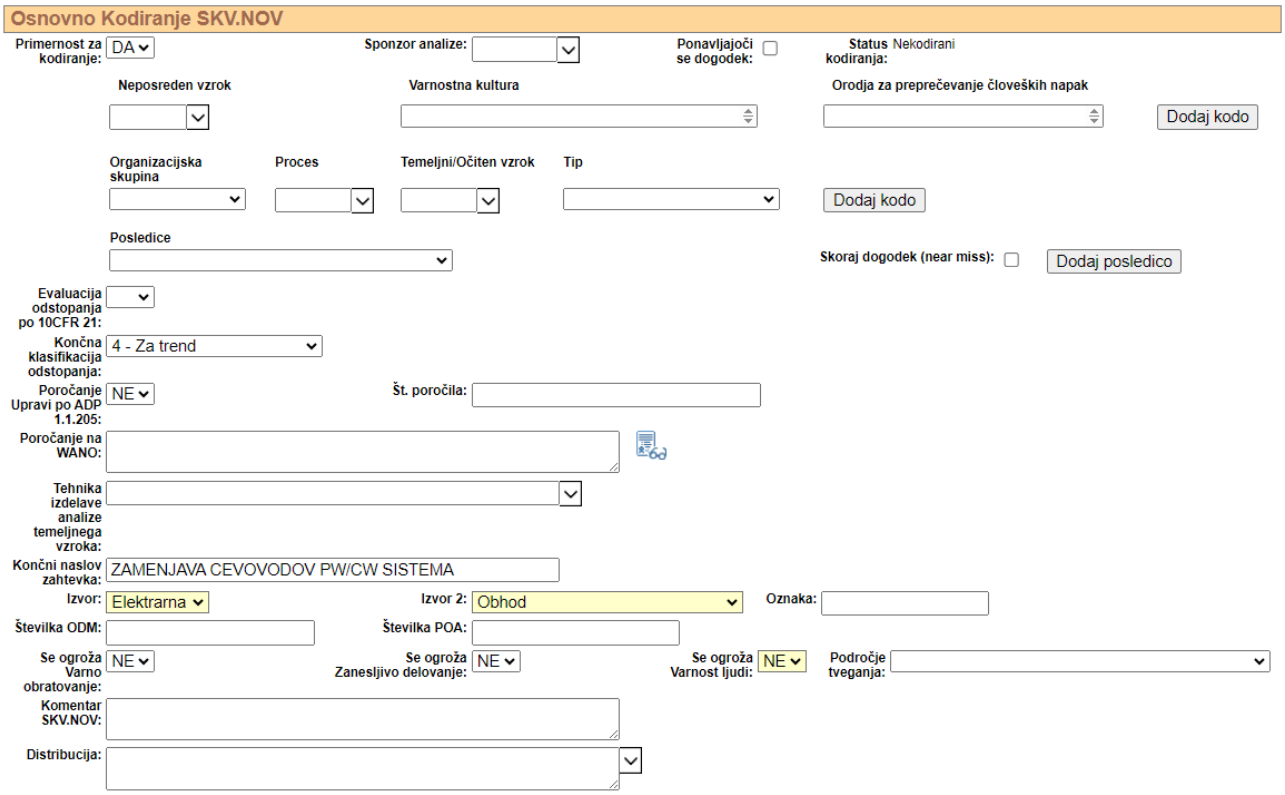

Figure 4: Coding page

The coding system consists of the following groups of codes:

- Direct Cause – is defined as the failure, action, omission, or condition which immediately produced (or led to) the event. These causes are often not correctable without investigation or analysis. The direct cause often explains how an event occurred but usually does not explain why it happened. It could be any of the different kinds of mechanical, electrical, or I&C failure, external damaging condition or human related cause (a set of 66 codes).
- Organizational Unit – defines the organizational unit where a casual factor occurred or refers to the organizational unit that could learn the most from the adverse condition.
- Plant Process – defines the process that directly caused the adverse condition and requires improvement, i.e., maintenance, operation or engineering processes, organizational processes, configuration control and other (a set of 115 codes). Safety culture and safety at work processes codes are also available.
- Casual Factor – any factor that initiates an event, contributes to its outcome, or exacerbates its consequences. Causal factors can be selected from groups like physical ergonomics, equipment, human performance, organisational control, organisational effectiveness and external (a set of 225 codes).
- Causal Factor Type – defines if a causal factor is a root or apparent cause, a contributing factor or just a probable cause.
- Consequences – defines all the consequences of the adverse condition (a set of 30 codes).
- Significance Level – 4 levels of significance are being used: *significant condition adverse to safety* – level 1, *events adverse to safety* – level 2, *significant events* – level 3, and *for trend only* – level 4.

The Corrective Action Program coding is first suggested by the staff responsible for the action request or event analysis. Verification and final coding, however, are carried out by the Independent Safety Engineering Group members. Among the above mentioned groups of codes, the causal factor

coding is the most important one for a successful resolution of deviations, prevention of repeat events and for effective trending. The set of causal factor codes is presented in the form of a tree diagram for a more convenient use.

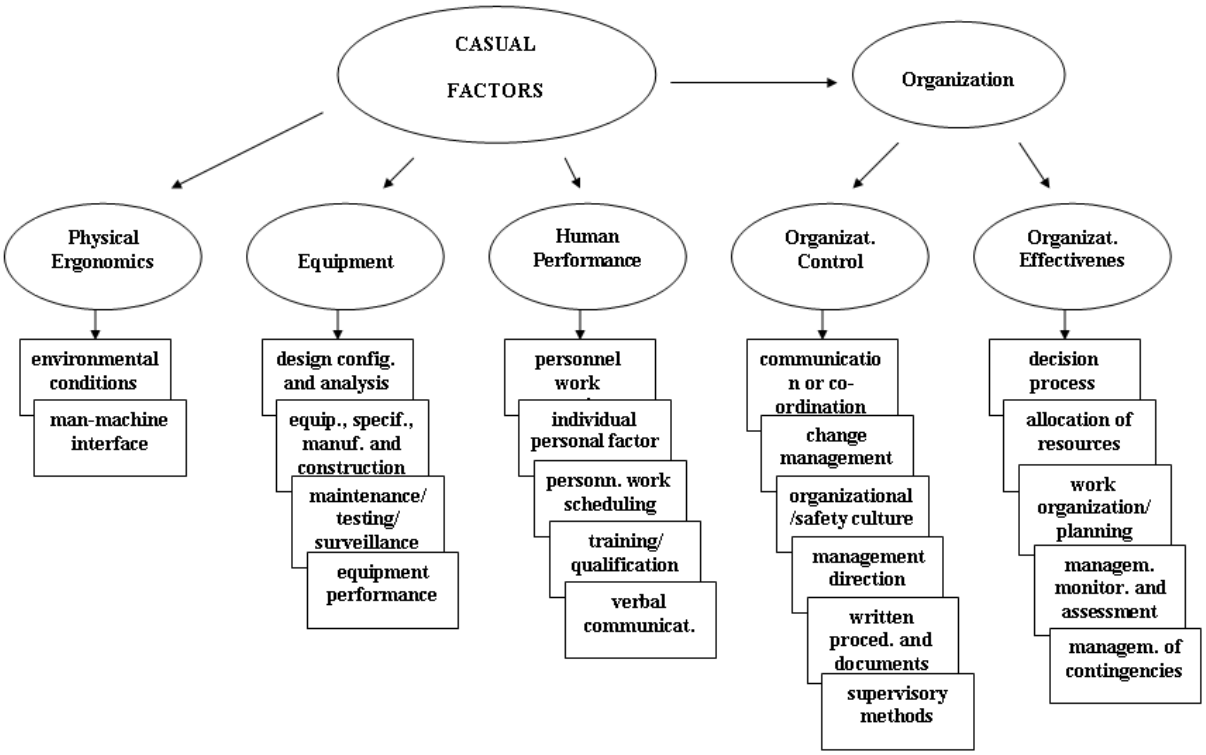

Figure 5: Causal factor coding system tree

Each of the 22 sub-groups in a causal factor tree contains a set of causal factors that defines the sub-group. For example, the *Individual personal factors* sub-group contains the following codes:

1800 Other
1801 Unidentified
1802 Overconfidence
1803 Fatigue / stress
1804 Perceived lack of time
1805 Boredom / inadequate motivation
1806 Skill of the craft less than adequate
1807 Not familiar with job performance standards
1808 Unawareness
1809 Tunnel vision
1810 Mindset
1811 Fear of failure
1812 Lack of feeling for proactive behaviour
1813 Lack of capability to anticipate error-likely situation
1814 Personality conflicts

Closely connected to the Causal Factor code is the Causal Factor Type that defines the meaning of the assigned code. The same codes can be used as a root or apparent cause, a contributing factor or just a probable cause, depending on the type of analysis provided and on the certainty of the cause defined by analysis. Based on the analysis findings, a list of predefined questions is associated with each sub-group of casual factors, and this enables quick identification of appropriate casual factor codes for adverse conditions and selection from the pick-up list.

3 RESULTS

In 2023, 2984 Corrective Action Program requests were opened at the Krško NPP, of which 93 requests were classified as significance 3 or higher and found suitable for coding. For various reasons, not all of them have been coded yet. Groups of causal factors assigned to requests are presented in the chart below:

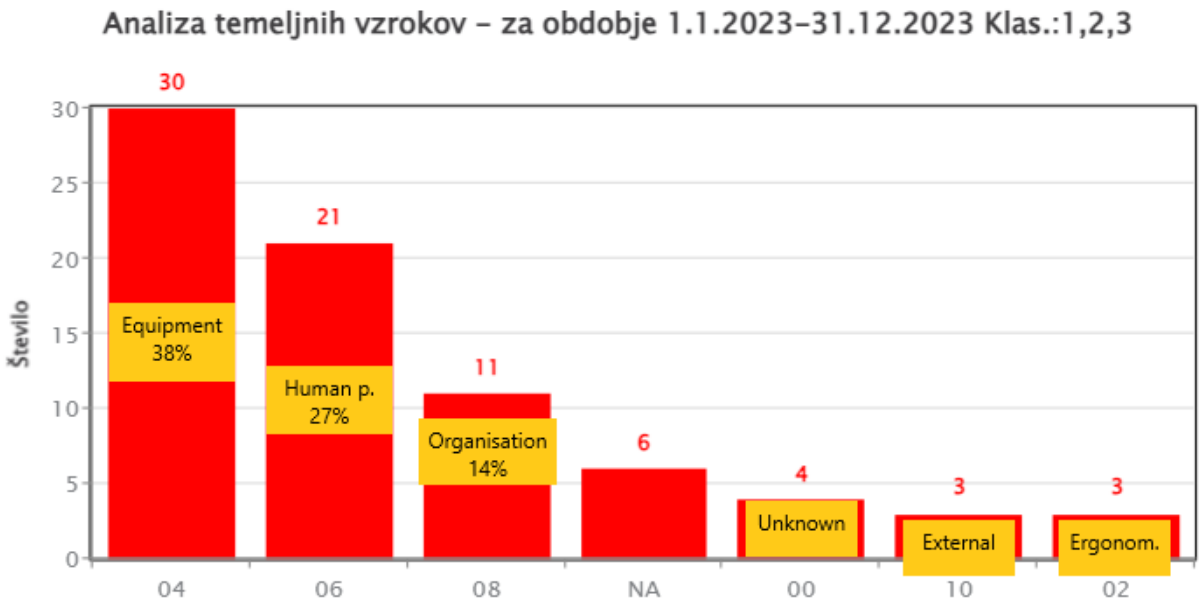

Figure 6: Analysis of causal factors for the year 2023

When the first and most representative group of causal factors is selected, a drill-down to subgroups is performed. In each group of causal factors there is a various number of sub-groups.

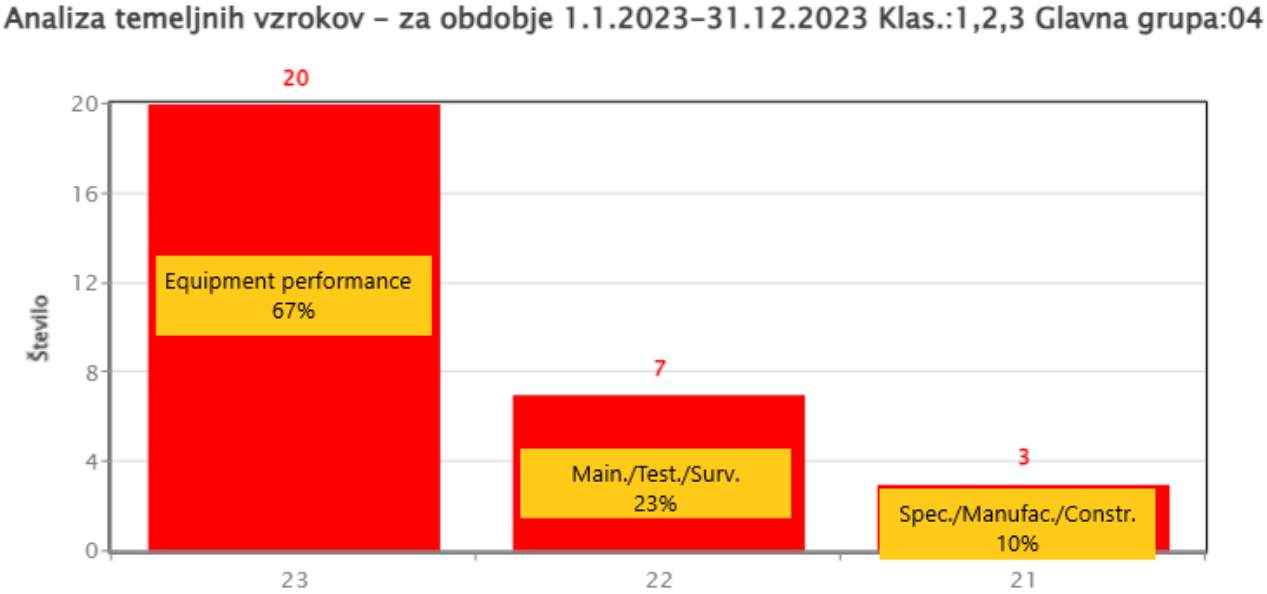

Figure 7: Analysis of casual factors for the year 2023 – Equipment drill-down

Further drill-down of the largest subgroup returns causal factors selected from this sub-group.

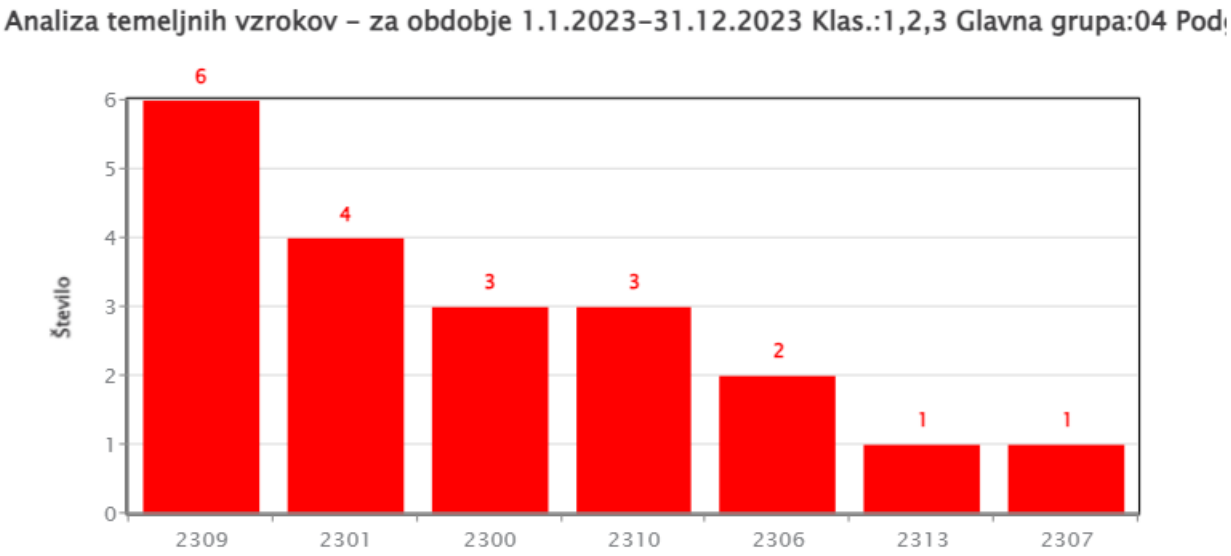

Figure 8: Analysis of causal factors for 2023 – Equipment performance drill-down

2309 – Degraded subcomponent contributed to failure
2301 – Unidentified
2300 – Other
2310 – Component aging
2306 – Insufficient monitoring of component
2313 – Equipment erosion/corrosion
2307 – Externally damaging condition not corrected

Based on these results, the predominant causal factor can be recognized. This information can be used for correcting plant equipment, processes, or human behaviour in such a way to eliminate or decrease frequency of this causal factor. In this manner, the frequency of certain types of deviations is decreased and this also influences the frequency of more significant events. This information can also be used in the trend analysis of deviations through a longer period.

4 CONCLUSION

The level of Corrective Action Requests coding depends on the level of investigation of the deviations described in the request and on the level of significance associated with the request. For the requests marked as *for trend only*, the most basic coding is provided based on the direct cause and consequence coding. Causal factor coding is more demanding and time consuming and it is reserved for higher significance request only. The prerequisite for getting relevant results from the Corrective Action Program database is to provide and record relevant and high quality data, and to maintain consistency in the coding of data and compliance with the prescribed rules. To ensure consistency in the coding of data, the number of well synchronized coders should be as low as possible (two or three persons who maintain good communication). Therefore, causal factor coding at NEK is always verified and finalized by Independent Safety Engineering Group engineers.

REFERENCES

[1] Bailey, Carol A. 2007. *A Guide to Qualitative Field Research.* 2nd ed. Thousand Oaks, CA: Pine Forge Press, Sage Publications.