



Executive Summary ...

# RiskNIS Package "A" –

(May 2008, final report)

## Risk management and use of risk-based approaches in inspection, maintenance and HSE analyses of NIS a.d. plants



- NIS A.D.
- RGE
- RNP
- RNS
- MSEQ 20
- RBI Quali



... under the contract between the Petroleum Industry of Serbia (NIS a.d.) and Steinbeis Advanced Risk Technologies, Germany, in the first package of the project (Project "A") the comprehensive critical review of the state of NIS assets (Basic Resource Document) has been made and the integrated web-based system for Risk-based inspection (RBI), Reliability Centered Maintenance (RCM), Root Cause Failure Analysis (RCFA) and Health, Safety and Environment analysis installed and applied on over 2,000 sample cases (units, systems, pieces of equipment – approx. 6 times more than initially

planned). Approx. 300 participants of the corresponding training, education and certification measures have gained the professional skills needed to apply the methods and use the system.

RCM, RCFA, HSE and HSSE systems allow to include safety, environmental, business and reliability considerations

### Information Database: Objects

- Site/Location: 3
- Unit: 65
- Static Equipment - Vessels: 617
- Rotating Equipment: 1122
- Electrical Equipment: 7
- Electronical Equipment/P&D: 4
- Misc. Equipment: 67
- Static Equipment - Heat exchangers, boilers and furnaces: 831
- Static Equipment - Piping: 211
- Company: 1



### Analyses

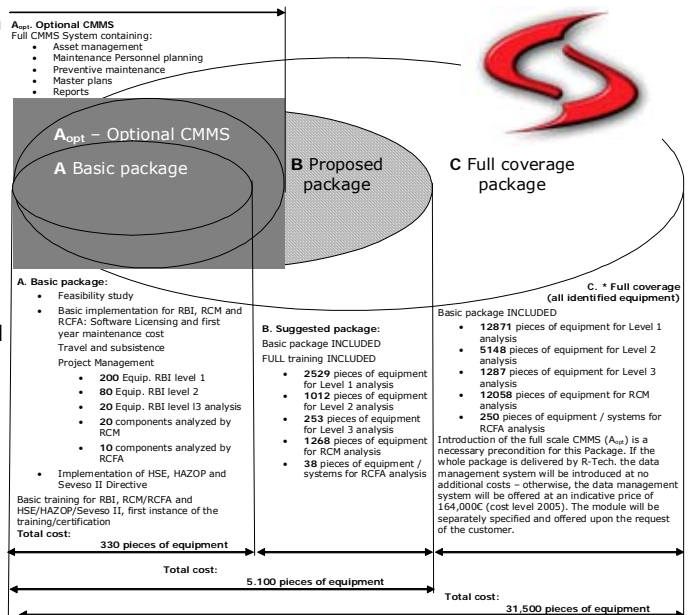
- HAZOP Analysis: 5
- Management Systems Evaluation Questionnaire: 7
- RBI Qualitative Component Based (level I): 641
- RBI Qualitative Unit Based: 61
- RBI Quantitative (Level III): 63
- RBI Semi-quantitative (level II): 96
- RCM/RCFA Analysis: 244

into the decision making process and, thus, provide better targeting of resources and improving the results of the run-replace-repair decisions, as well as in the overall operation, safety, inspection and maintenance. This is accomplished by considering the risks of possible undesirable events, the risk itself being expressed as the likelihood of the event (in a given scenario) multiplied by its probable consequences. Properly developed, implemented and used, the RBI, RCM, RCFA and HSE/HSSE systems help to significantly optimize plant key performance indicators (KPIs) and assure safe, economical and, hence, competitive operation.

**Steinbeis Advanced Risk Technologies Solution:** RiskNIS project proposes a RBI, RCM, RCFA and HSE/HSSE solution

which is transparent and affordable. This solution is based on innovative, but recognized methodologies (USA, EU), used nowadays by the leading industrial companies, and the state-of-the-art software tools. The solution provides support for successful application of RBI, RCM, RCFA and HSE in shortest possible time and, in most of the cases without having to change/replace the existing system(s).

### RBM (Risk Based Management), RBI,



- RNP
- Energana
- HPV
- Manipulacija
- S-0100
- S-0200
- S-0250
- S-0290
- S-0300
- S-0400
- S-0500
- S-0550
- S-0570
- S-0600
- S-0620
- S-0650
- S-0750
- S-0850
- S-0900
- S-1000
- S-1300
- S-1500
- S-1520
- S-1550
- S-1700
- S-1800
- S-2050
- S-2100
- S-2200
- S-2300 - FCC
- S-2400
- S-2450 - Claus
- S-2500
- S-2550
- S-2600
- S-2650
- S-2660
- S-2700
- S-2750
- S-2850
- S-2900
- S-2950
- S-3600
- MSEQ: Feasibility
- MSEQ: First Eval

**Data/Asset Management – Base Resource Document – “1,000 questions of RiskNIS”**

Questionnaire	Legal aspects	Current practice	Equipment and tools	Qualification / certification	Managem. aspects	Expectation in the future
Management. NA						
I Inspection RBI	RNP	RNP I.1	RNP I.2	RNP I.3	RNP I.4	RNP I.5
	RNS	RNS I.1	RNS I.2	RNS I.3	RNS I.4	RNS I.5
	RGE	RGE I.1	RGE I.2	RGE I.3	RGE I.4	RGE I.5
Management. NA						
II Maintenance RCM/RCFA	RNP	RNP II.1	RNP II.2	RNP II.3	RNP II.4	RNP II.5
	RNS	RNS II.1	RNS II.2	RNS II.3	RNS II.4	RNS II.5
	RGE	RGE II.1	RGE II.2	RGE II.3	RGE II.4	RGE II.5
Management. III 1 III 2 III 3 III 4 III 5 III 6						
III HSE	RNP	RNP III.1	RNP III.2	RNP III.3	RNP III.4	RNP III.5
	RNS	RNS III.1	RNS III.2	RNS III.3	RNS III.4	RNS III.5
	RGE	RGE III.1	RGE III.2	RGE III.3	RGE III.4	RGE III.5
Management. IV 1 IV 2 IV 3 IV 4 IV 5 IV 6						
IV ITI	RNP	RNP IV.1	RNP IV.2	RNP IV.3	RNP IV.4	RNP IV.5
	RNS	RNS IV.1	RNS IV.2	RNS IV.3	RNS IV.4	RNS IV.5
	RGE	RGE IV.1	RGE IV.2	RGE IV.3	RGE IV.4	RGE IV.5
Management. V 1 V 2 V 3 V 4 V 5 V 6						
V General Management	RNP	RNP V.1	RNP V.2	RNP V.3	RNP V.4	RNP V.5
	RNS	RNS V.1	RNS V.2	RNS V.3	RNS V.4	RNS V.5
	RGE	RGE V.1	RGE V.2	RGE V.3	RGE V.4	RGE V.5
Management. NA						
VI Plant specific issues	RNP	RNP VII - V110				
	RNS	RNS VII - V112				
	RGE	RGE VII				
Management. VII						
VII Project risks	RNP	RNP VII				
	RNS	RNS VII				
	RGE	RGE VII				

Cost Code / Type	BF
Technological Mark	BF - 2301
Manufacturing Number	3265
Manufacturer	Ferdinand Lentjes, Dusseldorf
Year of Manufacture	1981
Type of Vessel	PPP
Vessel Class	II
Design Pressure (tubes)	54
Hydrotest pressure (tubes)	68
Design Temperature (shell)	475

- Maintenance (RCM)
- Health, Safety and Environmental practices
- General Management practices and
- Plant specific issues

In Package “A” data collected have been stored (a) the survey tool, (b) single analyses tool and (c) document (IT/paper) form, and are ready for the storage in CMMS tool of Package “A<sub>opt</sub>”.

Web-based survey/overview of assets has covered virtually all aspects of NIS assets in:

- RNP refinery (Pančevo)
- RNS refinery (Novi Sad)
- RGE refinery (Elemir)

looking at:

- Legal aspects
- Current practice
- Equipment and tools
- Qualification and certification
- Management aspects and
- Expected changes in future practice.

The summary reports based on the answers were reviewed by the independent experts and used as a starting point for:

- Data acquisition
- Inspection (RBI)

**Unit-based analyses and management system assessment**

65 Analyses has been done at the unit level for different NIS units and they were the first indication for the areas where data were missing – many units were classified in higher risk areas primarily because of the missing, not updated or uncertain data. They were also the bases for the “bad actors” analyses performed under the RCFA activity.

7 Analyses of the management system in different units have shown the critical items for improvement of current management practices.



**RBI component analysis**

The RBI component analysis has covered

- 641 Level 1 analyses (planned 200)
- 96 Level 2 analyses (planned 90) and
- 63 Level 3 analyses (planned 20), including the financial effects.

The significantly increased number of analyses done was caused by the need of the plants to use already the results of the sample analysis (Package “A”).

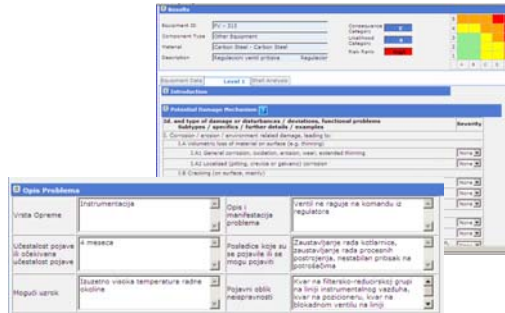
The tool has been customized to the needs of the situation and, in the area of RBI supports three main methods:

- RIMAP-based assessment (CEN CWA 15740)
- API 581 and
- The method applied by Shell Global Solutions in NIS.



### RCM/RCFA

Thanks to the seamless integration of RCM/RCFA with all the other elements of the overall system in the RiskNIS project it was possible to achieve economic benefits from the system already at the stage of sample applications (Package "A"). Most of the measurable benefits (s. below) result exactly from the application of the RCM/RCFA concept and the tool, because they indicated the weak points – more than 200 potential "bad actors" have been identified and analyzed within Package "A".



### IT Implementation

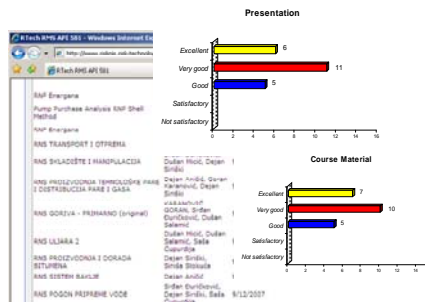


- One central data/application server running MS SQL Server database system for data collection, processing and presentation
- One central web server, based on MS IIS, with support for MS .Net applications
- Advantages:
  - Data stored at one place and available for all authorized persons through web-based interface
  - No client software, apart from the standard web browsers

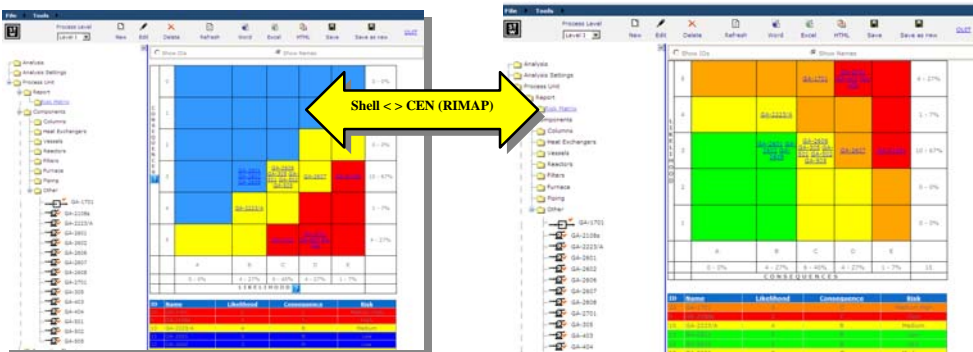
Maintenance and further development done on the central web- and data / applications servers only

### Training and Education

RiskNIS has not only had approx. 300 participants in the training and education sessions, several trainings organized in Germany, over 600 days of training and over 70 participants certified, but it has also provided the full-scale on-the-job training: approx about 1/3 of all analyses were done by NIS staff educated/trained in RiskNIS courses. The quality of the training was not proven by the satisfaction of the participants, but also by in the qualified discussions with the Serbian government and their Norwegian and other consultants (Shell).



### Additional work / deliverables: Increased number of analyses and alignment with Shell



The software system allows direct "switching" between different system – here between the CEN (RIMAP) and Shell matrices. This increases the flexibility and transparency of the system significantly. The concepts used in the RiskNIS project and in the system are embedded into the draft documents of the NIS Quality Management System. Package "A" has delivered additional deliverables in all items of the work plan: from increased number of components and analyses, up to features allowing better alignment with existing systems or systems introduced in parallel.

### RGE

#### RGE

- + C1 A/B
- + C1A/B (potis)
- + C1A/B (usis)
- + C2 A/B
- + C2A/B (potis)
- + C2A/B (usis)
- + D-1
- + D-101
- + D-102
- + D-103
- + D-104
- + D-11
- + D-111
- + D-112
- + D-12
- + D-120
- + D-121
- + D-122
- + D-16
- + D-2
- + D27A
- + D-27A
- + D27B
- + D-27B
- + D27C
- + D-27C
- + D27D
- + D-27D
- + D27E
- + D-27E
- + D27F
- + D-27F
- + D28A
- + D-28A
- + D28B
- + D-28B
- + D28C
- + D-28C
- + D28D
- + D-28D
- + D28E
- + D-28E
- + D28F
- + D-28F
- + D28G
- + D-28G

- [-] RNS
  - [+] 0200 HPV
  - [+] 0300 Pogon proizvodnje
  - [+] 30 Postrojenje pare i ko
  - [+] HF-400 Hidrofinising (H)
  - [+] HFH - 400 Postrojenje z
  - [+] KRB-400 Sistem baklje s
  - [+] Novolin
  - [+] Obrada\_otpadnih\_voda
  - [+] Storage and Maniuplatic
  - [+] Transportation and disp
  - [-] U-100 Atmosferska des
    - [+] PP-101A/S
    - [+] PP-103A/S
    - [+] PP-104
    - [+] PP-105
    - [+] TA-106
    - RBI Qualitative Unit E
    - HAZOP: Analysis for
  - [-] U-200 Vakuum destilacij
    - [+] PP-201A/S
    - [+] PP-202A/S
    - [+] PP-203A/S
    - RBI Qualitative Unit E
    - HAZOP: Analysis for
  - [-] U-2100 Atmosferska de
    - [+] A-2101C
    - [+] A-2101E
    - [+] A-2101F
    - [+] A-2105C
    - [+] A-2108
    - [+] E-51202
    - [+] F-512-01
    - [+] FRC-2147
    - [+] LRCALH-2132
    - [+] P(F)RC-2111C
    - [+] P(F)RC-2112C
    - [+] P(F)RC-2123C
    - [+] P(F)RC-2125C
    - [+] PISVAL-2103
    - [+] T(F)SVAL-2103
    - [+] T(F)SVAL-2104
    - [+] T(F)SVAL-2114
    - [+] T(F)SVAL-2117
    - [+] TS 23

### HSE results of Package "A"

ID	Node	Parameter	Guide Word	Cause	Consequence Description	SafeGuards	Safe Index
1	Regenerator PD-2302	Pressure	No	Valve 1 closed	Not hazardous	Indication to the operator	True

Main results of the Package "A" are introduction of the methodologies (HAZOP, Safety Report, Land Use Planning, Domino Effects...) and the corresponding preparation for the full-scale analysis. This is supposed to result in the NIS capacity to operate its plants under the EU legislation and obtain all the operating and other permits resulting from it. The HAZOP analyses performed provide also a basis for favorable negotiations of insurance/reinsurance conditions (e.g. based on EML).

### Economic results of Package "A": Direct and indirect benefits

Although the economic benefits were not foreseen for the Package "A", the RCM/RCFA application of the system, on the example of maintenance-related investment (pumps) resulted in savings of over 1 million €.

**Savings...**

**Compliance**

Comments on the Safety Documentation for the NIS s. d. Refinery, Novi Sad, Serbia.

Additional deliverable contained in the delivery of the "German expert opinion" about the completeness, contents and results of the HSE report (Seveso II for RNP)

### Conclusion - Continuation

The main measurable economic benefits of the project are projected in packages "B" and "C". Package "HSSE" will ensure compliance with the new regulation. Possible package "A<sub>opt</sub>" would decisively improve the management system (CMMS). Continuation of the project in terms of packages and projects is shown below:

#### Packages:

- "B" – assessing a complete ("pilot") plant – FCC of RNP is planned
  - "C" – assessing the complete assets of NIS (estimated approx. 30,000 components)
  - "HSSE" – health, safety, security, environment – with the goal of providing the basis for obtaining the IPPC integrated operation permit
- optionally
- A<sub>opt</sub> with the goal of introducing the full-scale CMMS system

#### Follow-up projects:

- The DEG project "ESPRIT: Enhancing Industrial Safety, Environmental Protection and Risk Management in Serbia by means of dedicated Training, Education and Technology Transfer" – expected start June 15, 2008; direct link to the RiskNIS Package "HSSE"
- FP7 project "iNTeg-Risk: Early Recognition, Monitoring and Integrated Management of Emerging, New Technology Related, Risks" – expected start Sept. 1, 2008; direct link and dependency of RiskNIS Package "B"

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