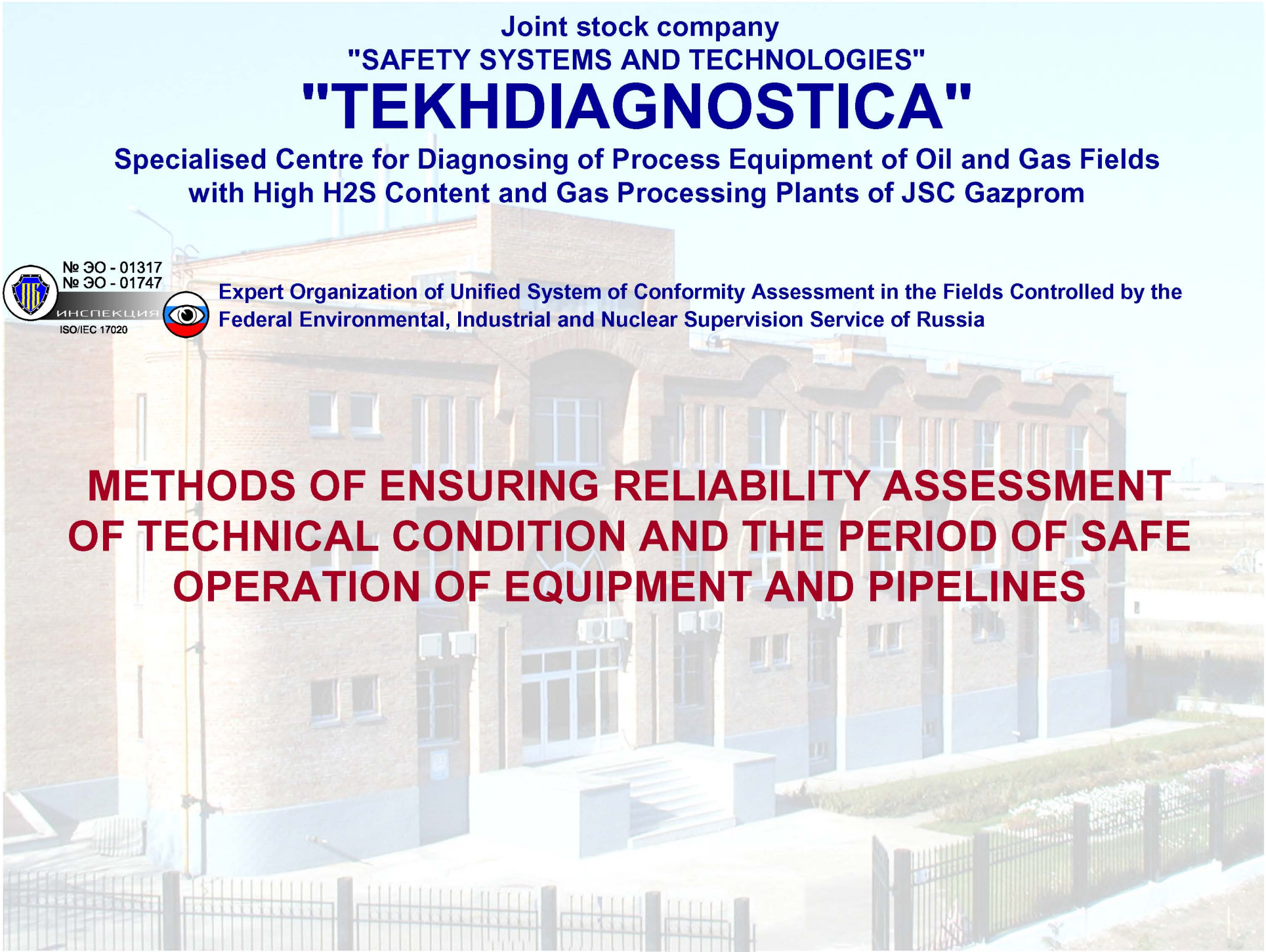
Joint stock company
"SAFETY SYSTEMS AND TECHNOLOGIES"

"TEKHDIAGNOSTICA"

Specialised Centre for Diagnosing of Process Equipment of Oil and Gas Fields with High H2S Content and Gas Processing Plants of JSC Gazprom

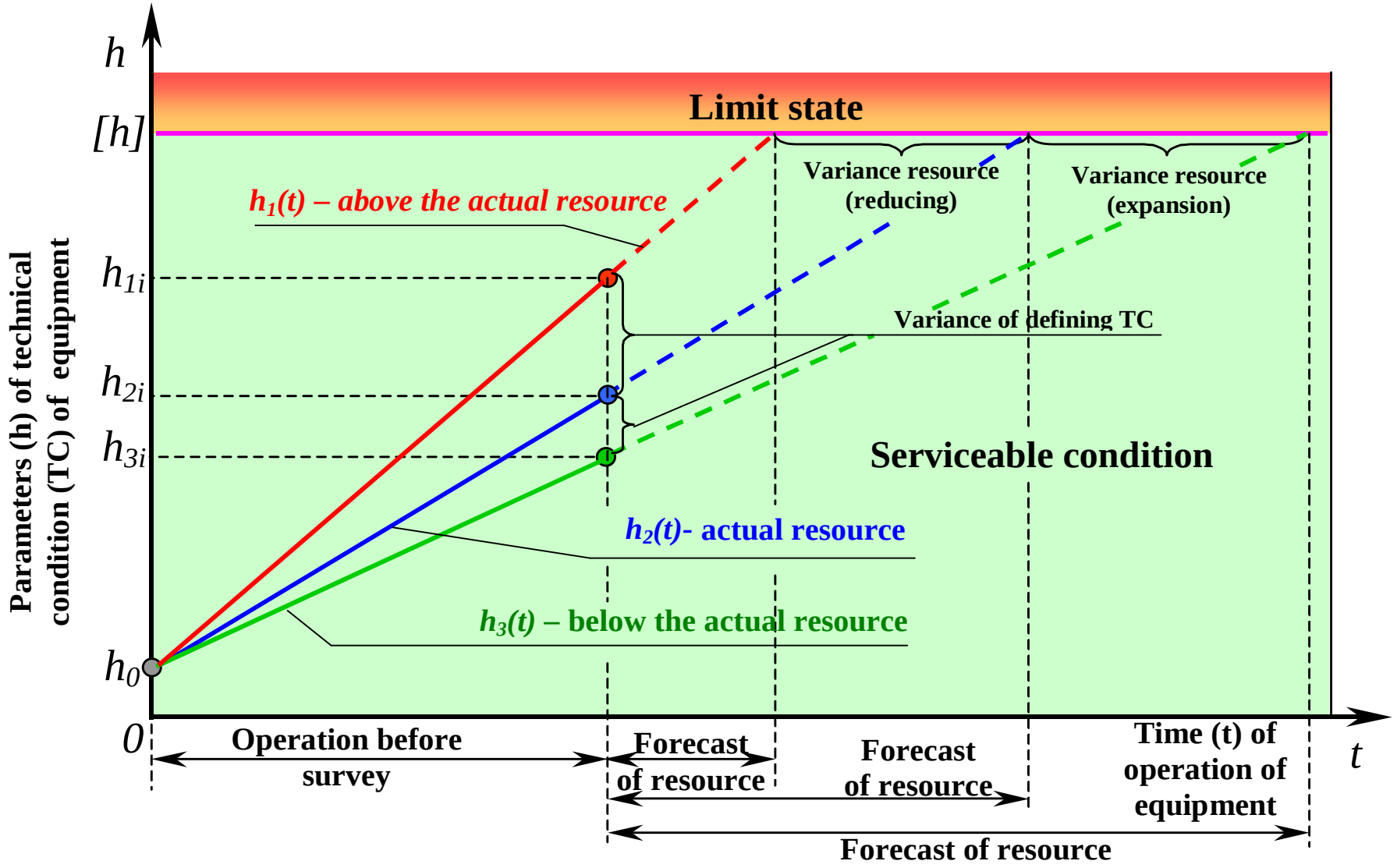
№ ЭО - 01317
№ ЭО - 01747
ИНСПЕКЦИЯ
ISO/IEC 17020

Expert Organization of Unified System of Conformity Assessment in the Fields Controlled by the Federal Environmental, Industrial and Nuclear Supervision Service of Russia



METHODS OF ENSURING RELIABILITY ASSESSMENT OF TECHNICAL CONDITION AND THE PERIOD OF SAFE OPERATION OF EQUIPMENT AND PIPELINES

CONDITIONAL GRAPHIC PRESENTATION CAUSES OF ORIGIN FORECASTING ERRORS OF RESIDUAL LIFE



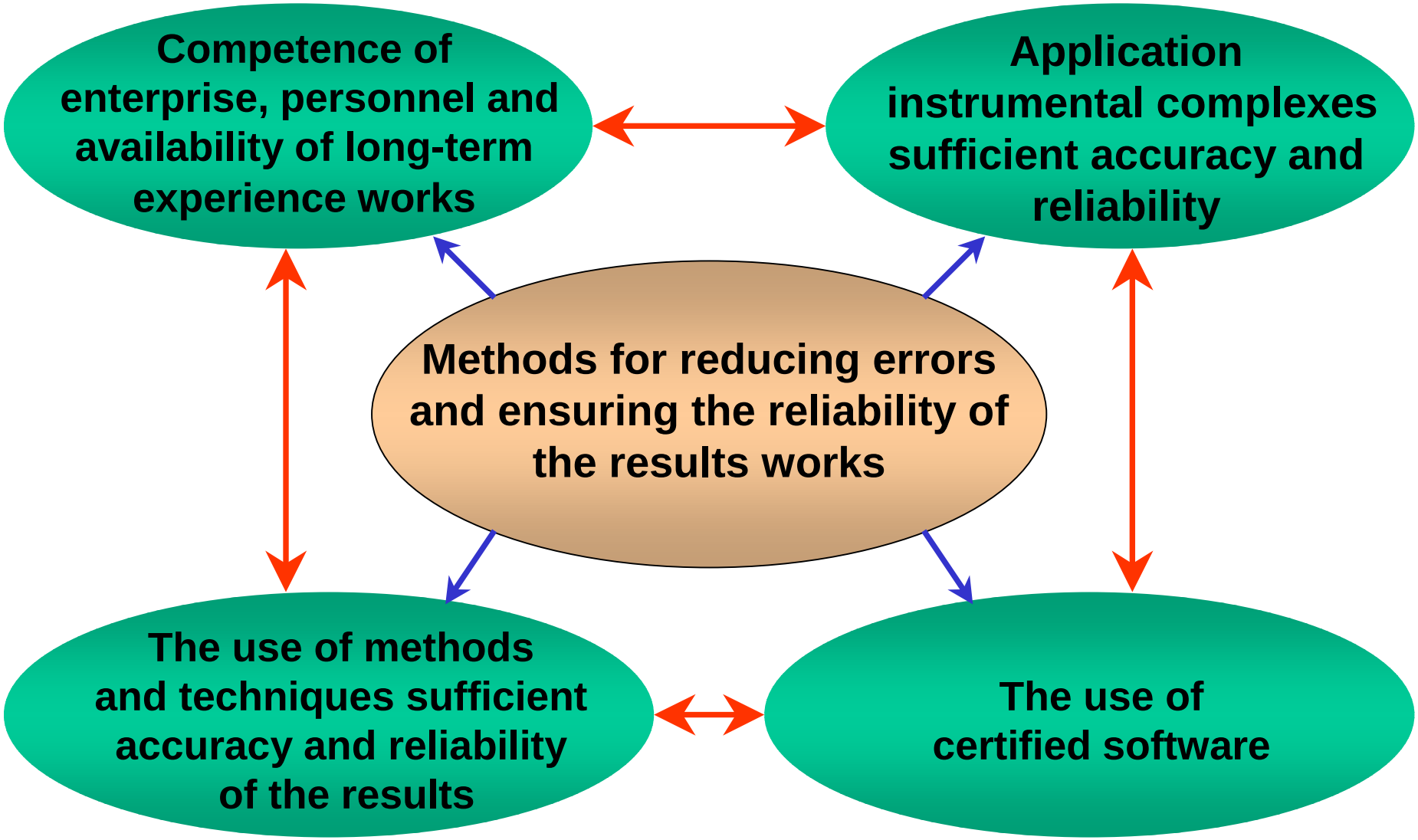
WORK EXPERIENCE AND METHODS OF TECHNICAL CONDITIONS (TC) RATING AND RESOURCE

Works stages	Methods
Establish baseline (h_0), intermediate ($h_{1 \div (i-1)}$) TC parameter values and time of operation of equipment (t_{ki})	Analysis of technical documents - project, the executive, repair, operating, on earlier surveys, interim monitoring, etc.
Determination of the current (h_i) values of the parameters TC`s	Non-destructive, damaging and destructive methods of testing
The identification of loads and impacts	Analysis of operational documentation and applying methods of experimental mechanics
The Identification of possible limit state (LS)	Analysis of damage, load impacts and criterial characteristics of the metal
Defining criteria [h] assessment TC	Analysis of regulatory requirements and restrictions, settlement and experimental methods for evaluating the strength, reliability and survivability by several criterias of LS (LS)
The definition of change low of TC parameters of temporary $h_i(t)$ patterns	Approximation baseline (h_0), intermediate ($h_{1 \div (i-1))}$ and ongoing (h_i) values of the parameters TC and defining the parameters of mathematical regularities $h_i(t)$ and it's changes
Prediction of residual resource (τ)	Extrapolation $h_i(t)$, and time to achieve the current values (h_i) criteria [h]
Defining the term and conditions of safe operation until the next diagnostic survey	An analysis of the regulatory requirements for the security and safety of the resource definition, taking into account the reliability of forecasting τ, the volume control and TC severity of possible resource bounce

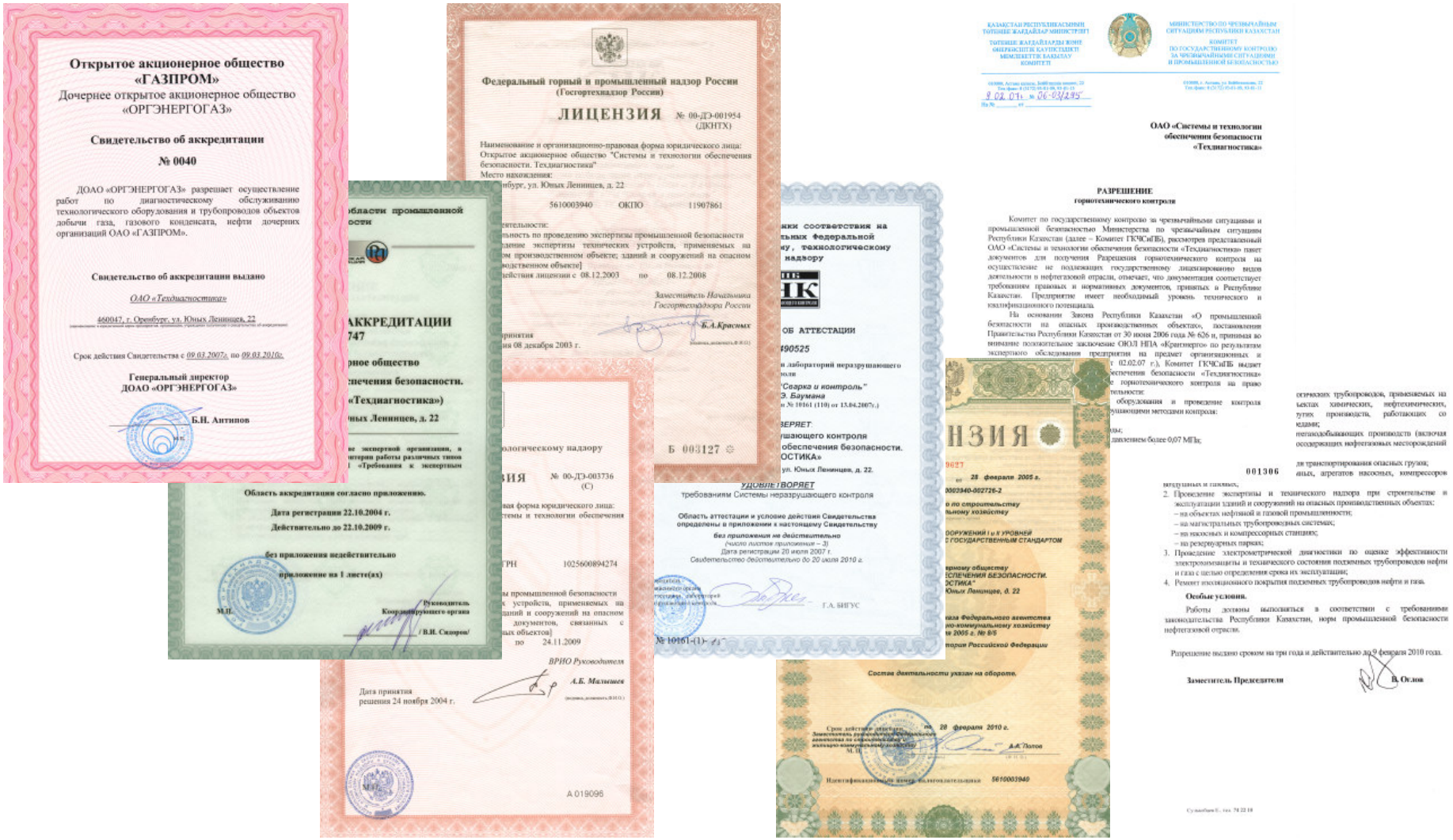
PHYSICS OF FAILURES AND LIMIT STATES OF EQUIPMENT

Mechanism of failure	Possible limits of the state	Parameters and evaluation criteria of TC
Corrosion (erosion) wear	**- viscous destruction; - leak**	**Actual and dropout (estimated), the wall thickness on the criteria of the static strength**
Changing the mechanical characteristics of the metal	**- destruction (viscous, delicate)**	**The speed of change and assessment of the actual properties for the projected period of operation**
H_2S corrosion cracking	**- the emergence of macro cracks and fragile destruction**	**The actual and allowable value of conditional like cracks damages to brittle fracture resistance criterion**
Changes of the critical temperature of fragility (metal embrittlement)	**- delicate destruction**	**The actual and allowable value of conditional like cracks damages, given the temperature of fragility**
Cyclic loading	- fatigue cracking, and the emergence of macro cracks and delicate destruction	The actual and allowable number of load cycles
Metal creep	- invalid forming; - distortionary aging and fragile destruction	Actual and dropout (estimated), the wall thickness on the criteria of the prolonged strength

APPROACHES TO ENSURE THE ACCURACY



COMPETENCE OF THE ENTERPRISE



Открытое акционерное общество
«ГАЗПРОМ»
Дочернее открытое акционерное общество
«ОРГЭНЕРГОГАЗ»

Свидетельство об аккредитации
№ 0040

ДОАО «ОРГЭНЕРГОГАЗ» разрешает осуществление работ по диагностическому обслуживанию технологического оборудования и трубопроводов объектов добычи газа, газового конденсата, нефти дочерних организаций ОАО «ГАЗПРОМ».

Свидетельство об аккредитации выдано

ОАО «Техдиагностика»

460047, г. Оренбург, ул. Юных Ленинцев, 22

Срок действия Свидетельства с 09.03.2007г. по 09.03.2010г.

Генеральный директор
ДОАО «ОРГЭНЕРГОГАЗ»
Б.Н. Антипов

Федеральный горный и промышленный надзор России
(Госгортехнадзор России)

ЛИЦЕНЗИЯ № 00-ДЭ-001954 (ДКНТХ)

Наименование и организационно-правовая форма юридического лица:
Открытое акционерное общество "Системы и технологии обеспечения безопасности. Техдиагностика"
Место нахождения:

5610003940 ОКПО 11907861

Срок действия лицензии с 08.12.2003 по 08.12.2008

Заместитель Начальника Госгортехнадзора России
Б.А.Красных

Область аккредитации согласно приложению.

Дата регистрации 22.10.2004 г.

Действительно до 22.10.2009 г.

без приложения недействительно

Руководитель Координирующего органа
/ В.Н. Сизоров/

№ 00-ДЭ-003736 (С)

ГРН 1025600894274

по 24.11.2009

ВРИО Руководителя
А.Б. Малышев

Дата принятия решения 24 ноября 2004 г.

А 019096

Б 003127

УДОСТОВЕРЯЕТ
требованиям Системы неразрушающего контроля

Область аттестации и условие действия Свидетельства определены в приложении к настоящему Свидетельству

без приложения не действительно
(число листов приложения – 3)
Дата регистрации 20 июля 2007 г.
Свидетельство действительно до 20 июля 2010 г.

Г.А. БИГУС

№ 10161-(1)-

Состав деятельности указан на обороте.

28 февраля 2010 г.

А.К. Попов

5610003940

КАЗАКСТАН РЕСПУБЛИКАСЫНЫН ТӨТЕНШЕ ЖАҒДАЙЛАР МИНИСТРЛІГІ
ТӨТЕНШЕ ЖАҒДАЙЛАРДЫ ЖОЮ ОПЕРАЦИЯЛЫҚ ҚАУІПСІЗДІГІ МЕМЛЕКЕТТІК БАҚЫЛАУ КОМИТЕТІ

МИНИСТЕРСТВО ПО ЧРЕЗВЫЧАЙНЫМ СИТУАЦИЯМ РЕСПУБЛИКИ КАЗАХСТАН
КОМИТЕТ ПО ГОСУДАРСТВЕННОМУ КОНТРОЛЮ ЗА ЧРЕЗВЫЧАЙНЫМИ СИТУАЦИЯМИ И ПРОМЫШЛЕННОЙ БЕЗОПАСНОСТЬЮ

ОАО «Системы и технологии обеспечения безопасности «Техдиагностика»

РАЗРЕШЕНИЕ
горнотехнического контроля

Комитет по государственному контролю за чрезвычайными ситуациями и промышленной безопасностью Министерства по чрезвычайным ситуациям Республики Казахстан (далее – Комитет ГКЧСиПБ), рассмотрев представленный ОАО «Системы и технологии обеспечения безопасности «Техдиагностика» пакет документов для получения Разрешения горнотехнического контроля на осуществление не подлежащих государственному лицензированию видов деятельности в нефтегазовой отрасли, отмечает, что документация соответствует требованиям правовых и нормативных документов, принятых в Республике Казахстан. Предприятие имеет необходимый уровень технического и квалификационного потенциала.

На основании Закона Республики Казахстан «О промышленной безопасности на опасных производственных объектах», постановления Правительства Республики Казахстан от 30 июня 2006 года № 626 и, принимая во внимание положительное заключение ОЮЛ НПА «Красноярго» по результатам экспертного обследования предприятия на предмет организационных и

оборудования и проведение контроля

давлением более 0,07 МПа;

001306

2. Проведение экспертизы и технического надзора при строительстве и эксплуатации зданий и сооружений на опасных производственных объектах:
– на объектах нефтяной и газовой промышленности;
– на магистральных трубопроводных системах;
– на насосных и компрессорных станциях;
– на резервуарных парках;
3. Проведение электрометрической диагностики по оценке эффективности электрохимзащиты и технического состояния подземных трубопроводов нефти и газа с целью определения срока их эксплуатации;
4. Ремонт изоляционного покрытия подземных трубопроводов нефти и газа.

Особые условия.

Работы должны выполняться в соответствии с требованиями законодательства Республики Казахстан, норм промышленной безопасности нефтегазовой отрасли.

Разрешение выдано сроком на три года и действительно до 9 февраля 2010 года.

Заместитель Председателя
В. Оглов

COMPETENCE OF PERSONNEL: ATTESTATION

Qualifying certificates of non-destructive testing specialists

Submit theoretical exams on non-destructive testing

The competence of personnel in the domain of non-destructive testing is not only in the independent appraisals body, but the annual two-month training with the internal follow-qualify under the enterprise's Quality Management System.

In JSC "Tekhdiagnostica" employs more than 80 professionals IInd qualification level, including 16 specialists with experience of more than 10 years, 20 - with the experience of more than 5 years and 7 employers with more than 3 years experience. Also enterprise has 4 specialist of IIIrd qualification level.

COMPETENCE OF PERSONNEL: INTRAINDUSTRIAL TRAINING

Personnel practical exercises

Control node connections

Testing results of works

Exploring technology with hardness tester

Theoretical lessons on non-destructive testing

METHODS AND INSTRUMENTS

The company is staffed by a modern diagnostic equipment for all major non-destructive testing methods, business professionals trained and certified at least the level II of non-destructive testing qualifying for PB 03-440-02.
The major diagnostic methods and equipment are:

- visual inspection and measurements – endoscopes Olympus, VD-8. etc;

- acoustic methods (ultrasonic, acoustic emission) – defectoscopes Epoch IIIb, USN-52 etc., thickness testers DME DL, DMS, etc., ultrasonic scanner Canon M500/600, complex of acoustic emission A-Line 32D DDM;

- magnetic methods (magnetic particle, magnet-anisotropic) - defectoscopes Magnaflux Y-6, scanner-defectoscopes "Complex 2.05", etc.;

- control with penetrating substances (liquid penetrant , leak search) - liquid penetrant flaw inspection kit Sherwin, installation control tightness HBP-1;

- eddy current inspection - defectoscopes ED-400, UH-B "Locator" and other.

- thermal inspection (thermovision) - infrared image converter Thermo Tracer TH5104;

- vibration survey - Vibration Analysers TK-81, IRD FastTrak, "Topaz" etc.

Also, the staff of company was trained and attested to a destructive testing, including:

- the tensile testing;

- test knock on the bend;

- metallographic and fractographic tests;

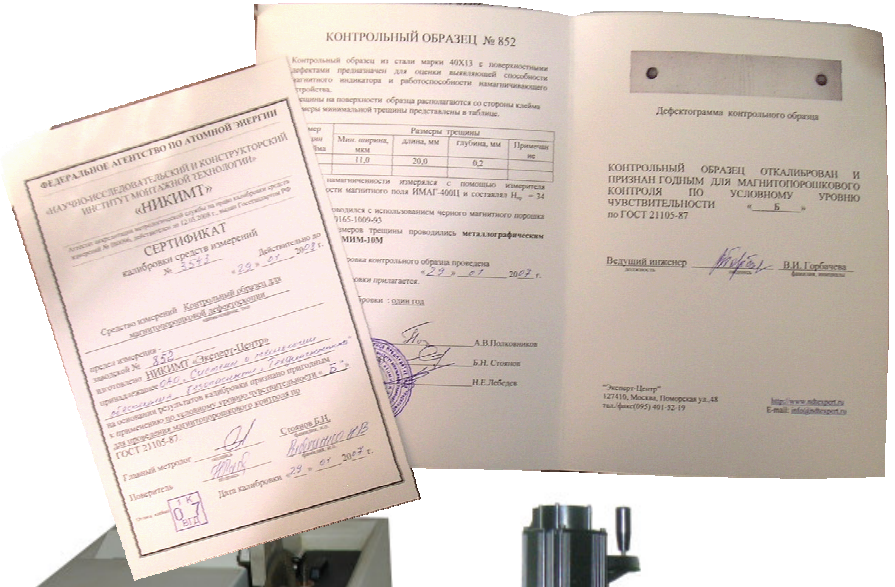
- hardness test with portable and stationary testers;

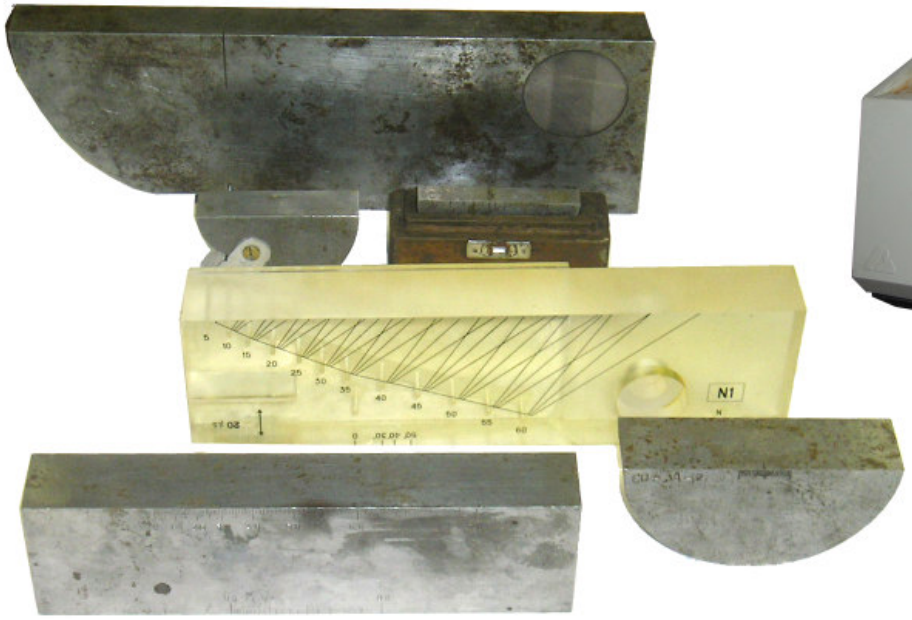
- spectrum analysis of chemical metal composition.

PROVISION OF MEASUREMENTS ACCURACY: STANDARDS AND CALIBRATION SAMPLES

Ensuring the reliability of the results of measurements carried out by every month settings diagnostic equipment using public samples and enterprise`s standard samples (ESS).

ESS are artificial defects with documented metrological characteristics.





Set of International and Public samples for USI

The company is equipped with equipment for the manufacture of standard samples required for the inspection

PROVISION OF MEASUREMENTS ACCURACY: EQUIPMENT CALIBRATION

In addition to state testing, as appropriate forces metrological laboratory specialists of JSC "Tekhdiagnostica" execute inter enterprise testing and calibration of measurement tools and other diagnostic equipment.

For calibration of ultrasonic flaw detectors used specialized calibration unit GSU UP-10PU.

Testing of thickness gages performed with exemplary measures flat bottom reflector wave (kit KMD-4).

PROVISION OF MEASUREMENTS ACCURACY: STATE TEST OF MEASURING TOOLS

All measurement tools used by the Laboratory of non-destructive testing are certificates of approval and the type of measurements made in the State Register of measuring

All devices moderated annual metrological verification.

Metrological testing devices running in the territorial department of Gosstandart of Russia – FSU "Orenburg CSMaC", as well as in other organizations who have the corresponding rights and registered in the Register of accredited metrology services.

NORMATIVE AND METHODOLOGICAL PROVISION

Legislation of Kazakhstan republic

Rules and safety standards

Regulations and other documents of MOE

GOSTs, OSTs, SNiPs, VSN, TU, RD and other

Procedures on the types of work

Foreign and Russian rules and regulations

API, ASME, ASTM, ISO, EN, etc.

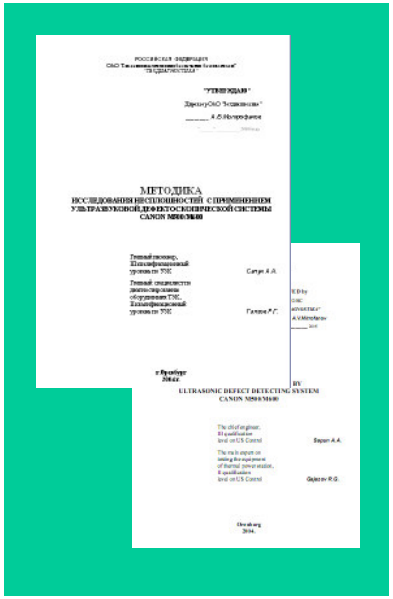
APPLIED TYPES OF NON-DESTRUCTIVE TESTING: ULTRASONIC INSPECTION

Ultrasonic tester "EPOCH IIIB"

Portable tester with function of wall thickness tester A1212 "Master"

A set of diagnostic equipment, placed in the car

APPLIED TYPES OF NON-DESTRUCTIVE TESTING: ULTRASONIC SCANNING

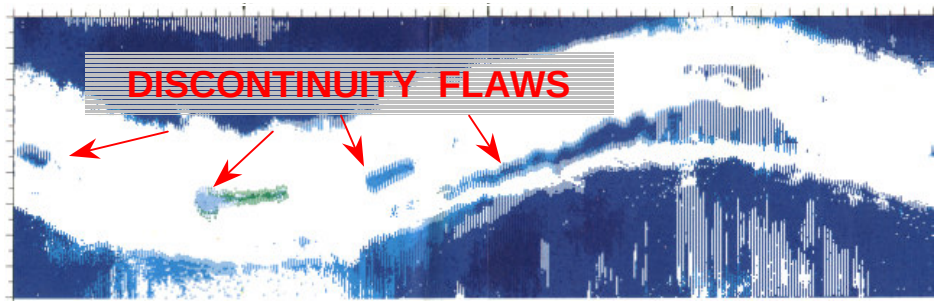

МЕТОДИКА
ИССЛЕДОВАНИЯ НЕСПЛОШНОСТЕЙ С ПРИМЕНЕНИЕМ
УЛЬТРАЗВУКОВОЙ ЦИФРОСКОПИЧЕСКОЙ СИСТЕМЫ
CANON M500/M600

ULTRASONIC DEFECT DETECTING SYSTEM
CANON M500/M600

Ultrasonic scanning connection node (UKPG-10, Orenburggazprom)

An automated ultrasonic scanning system Canon M500/600, which used by specialists of JSC "Tekhdiagnostica" in the diagnostic work, provides the required quality and reliability of the results of ultrasonic testing. Storage parameters and the results of ultrasonic control on removable media allows the periodic monitoring of equipment state with constant settings.

Defectogram of tangential weld



The work of a self-feed scanner (shell scanning) (amine regeneration column, KPK, KPO BV)

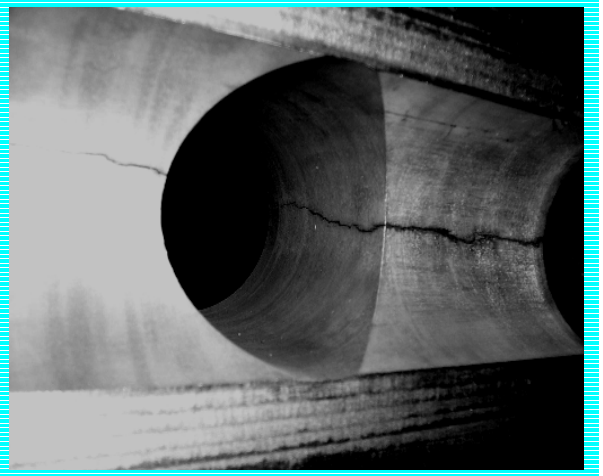
APPLIED TYPES OF NON-DESTRUCTIVE TESTING: EDDY CURRENT INSPECTION, MAGNETIC PARTICLE, LIQUID PENETRANT AND VISUAL INSPECTION

Eddy current inspection

Liquid penetrant inspection

Magnetic particle flaw detection

Visual inspection and measurements
of inner surface of the
heat exchanger tubes

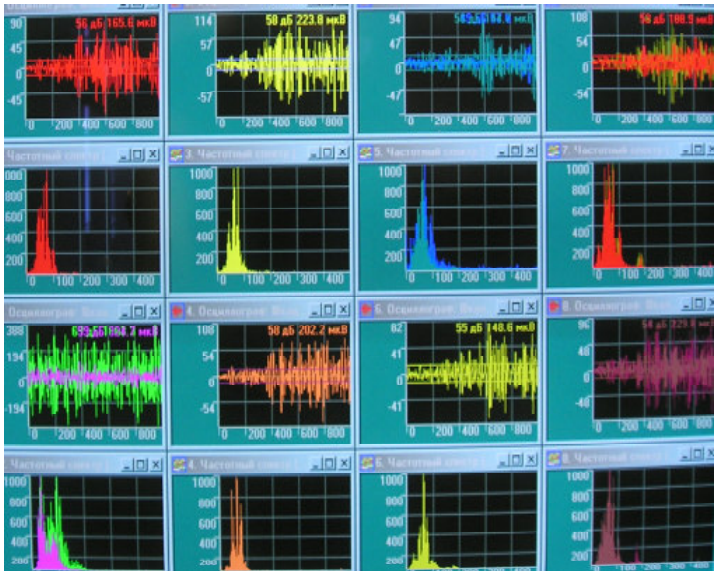


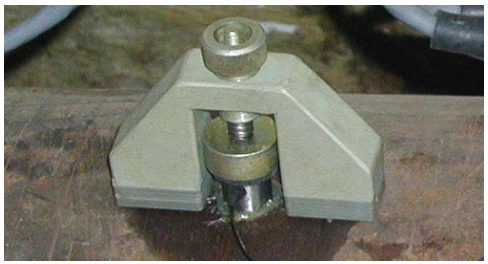
Defects identified by liquid penetrant and magnetic particle inspection

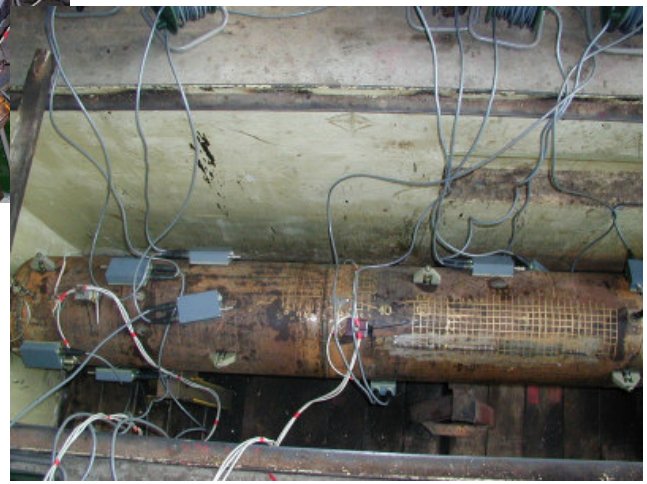
APPLIED TYPES OF NON-DESTRUCTIVE TESTING: ACOUSTIC EMISSION TEST

Digital set of acoustic-emission complex "A-Line 32D DDM" applies by specialists of JSC "Tekhdiagnostica" to perform non-destructive testing facilities, where the use of other methods of NDT labour or impossible - heat exchangers of cooling gases plant, air separation units, and as an escort of pneumatic overpressure test.

In order to improve the quality and reliability of acoustic-emission controls, the Centre of calculations and experiment (CCE) of JSC "Tekhdiagnostica" regularly conducts various research works to optimize the placement schemes of AE sensors, AE signal filtering and detection of acoustic waves emitted by various defects in the metal of equipment.







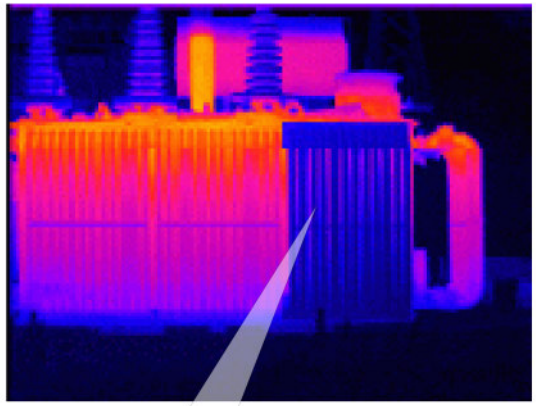
APPLIED TYPES OF NON-DESTRUCTIVE TESTING: THERMAL INSPECTION

Feature	Unit of measurement	Value
Measured temperature range	°C	-40 … +800
Sensitivity	°C	0.1
The horizontal angle of view	degrees	21.5
The vertical angle of view	degrees	21.5
The spatial resolution	radian	0.002
Cadre frequency sweep	Hz	22
Spectral range	mkm	3 … 5.3

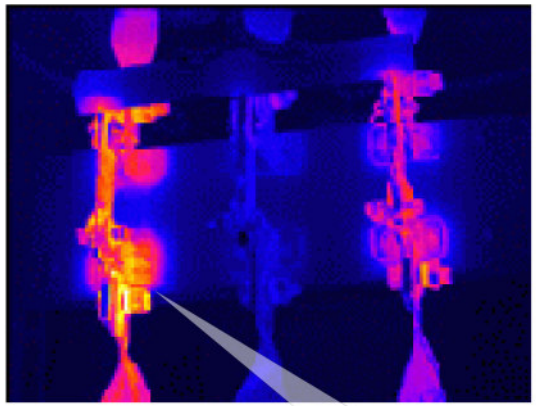
Thermovision unit Thermo Tracer (NEC san-ei, Japan)

Implementation of the thermal control

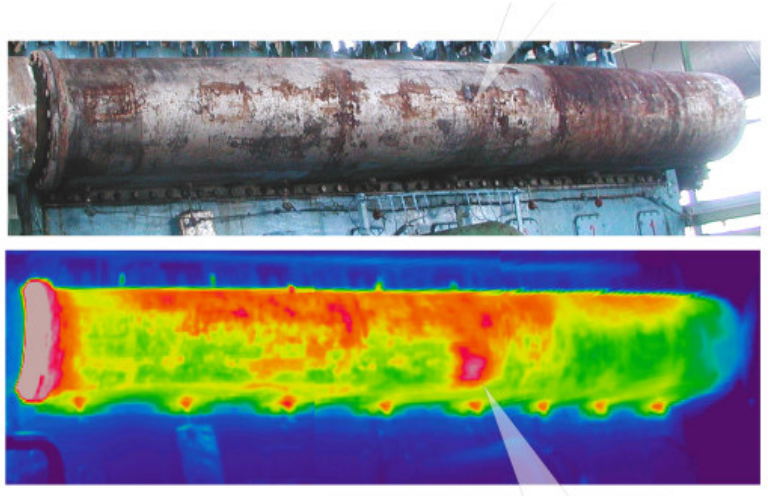
Visual display of overheating site collector are missing



Violation of the oil circulation through the radiator transformer



Overheating of bolt connecting



Area of overheating of exhaust collector of compressor

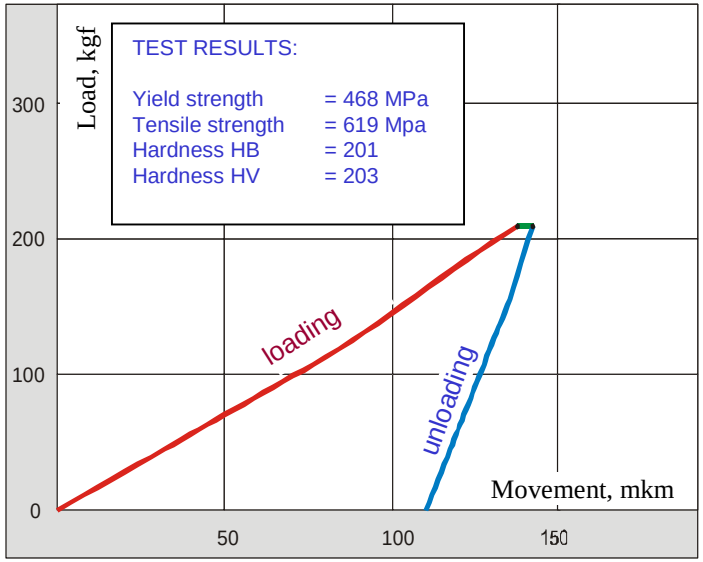
Samples of the defects identified with thermal control

DEFINITION OF MECHANICAL FEATURES, HARDNESS TEST

PIM-DV1 - device for determining the mechanical characteristics of materials with indentor penetration (above) and test results (below)

Stationary hardness tester HBRV-187,5

Determination of the hardness of metal with the help of portable hardness tester EQUOtip



For hardness measures JSC "Tekhdiagnostica" uses a variety of devices that implement methods of Brinell, Rockwell, Vickers, Leeb and ultrasonic contact impedance

SPECTRAL ANALYSIS OF CHEMICAL COMPOSITION OF METALS

Express analysis of the chemical composition of the metal of equipment components performed with portative spectrograph "Spectroport", allows to perform works on equipment without out of operation.

Предприятие
"ТЕХДИАГНОСТИКА"
460047, г.Оренбург,
ул. Юных Ленинцев, 22
Телефон 63-84-07
Телефакс 62-94-41

Протокол № 584

Наименование прибора: ***SPECTROPORT-F,*** *зав. номер :* ***8284/96,*** *изготовитель:* ***SPECTRO Analytical Instruments Gmbh***

Дата проведения анализа: ***17 августа 2007 г.,*** *объект контроля:* ***элементы ФА и КГ скважины № 103 СПХГ "Совхоз***

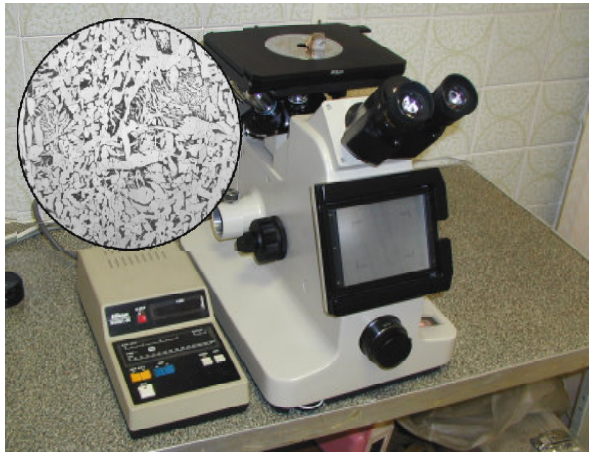
Элементы ФА и КГ	Сталь типа	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Cu
ТД-103-1	25ХГЛ ГОСТ 977-88	0.22	0.51	1.17	0.015	0.030	1.09	0.044	0.13	0.065	0.18
ТД-103-2	25ХГЛ ГОСТ 977-88	0.23	0.51	1.09	0.033	0.017	1.16	0.051	0.21	0.075	0.16
ТД-103-3	06Х20Н8М3Д2Л ТУ26-16-43-77	0.052	0.95	0.64	0.018	0.026	19.12	2.90	8.50	0.058	1.82
ТД-103-4	25ХГЛ ГОСТ 977-88	0.25	0.51	1.11	0.039	0.039	1.05	0.058	0.15	0.066	0.12
ТД-103-5	15Л ГОСТ 977-88	0.11	0.27	0.51	0.004	0.032	0.13	0.047	0.099	0.017	0.12
ТД-103-6	25ХГЛ ГОСТ 977-88	0.22	0.36	1.03	0.017	0.014	1.26	0.056	0.36	0.054	0.17
ТД-103-7	30Л ГОСТ 977-88	0.28	0.27	0.60	0.036	0.032	0.31	0.063	0.33	0.042	0.21
ТД-103-8	30Л ГОСТ 977-88	0.27	0.51	0.49	0.029	0.022	0.21	0.056	0.13	0.050	0.19
ТД-103-9	35ХГСЛ ГОСТ 977-88	0.27	0.78	1.31	0.026	0.031	0.85	0.050	0.32	0.033	0.12
ТД-103-10	30Л ГОСТ 977-88	0.32	0.42	0.48	0.038	0.036	0.22	0.049	0.11	0.026	0.12
ТД-103-11	30Л ГОСТ 977-88	0.37	0.51	0.60	0.028	0.036	0.15	0.046	0.054	0.054	0.11
ТД-103-12	25ХГЛ ГОСТ 977-88	0.20	0.49	0.93	0.015	0.023	1.06	0.044	0.13	0.054	0.16
ТД-103-13	20Л ГОСТ 977-88	0.27	0.51	0.63	0.025	0.032	0.19	0.057	0.092	0.060	0.12
ТД-103-14	15Л ГОСТ 977-88	0.12	0.43	0.53	0.024	0.035	0.20	0.051	0.12	0.042	0.12
ТД-103-15	25ХГЛ ГОСТ 977-88	0.23	0.51	1.09	0.038	0.026	1.03	0.055	0.23	0.070	0.25
ТД-103-16	30Л ГОСТ 977-88	0.37	0.51	0.50	0.029	0.023	0.25	0.065	0.12	0.098	0.12
ТД-103-17	30Л ГОСТ 977-88	0.37	0.49	0.51	0.029	0.023	0.25	0.065	0.11	0.098	0.12
ТД-103-18	35ХГСЛ ГОСТ 977-88	0.27	0.85	1.25	0.026	0.010	1.00	0.053	0.26	0.082	0.25
ТД-103-19	20Л ГОСТ 977-88	0.25	0.34	0.52	0.030	0.032	0.30	0.070	0.23	0.071	0.19
ТД-103-20	20Л ГОСТ 977-88	0.21	0.29	0.64	0.017	0.022	0.13	0.043	0.098	0.028	0.32

Руководитель работ *Целоусов А.И.*

Исполнитель работ *Лобода С.А.*

INVESTIGATION OF STRUCTURAL METAL PROPERTIES

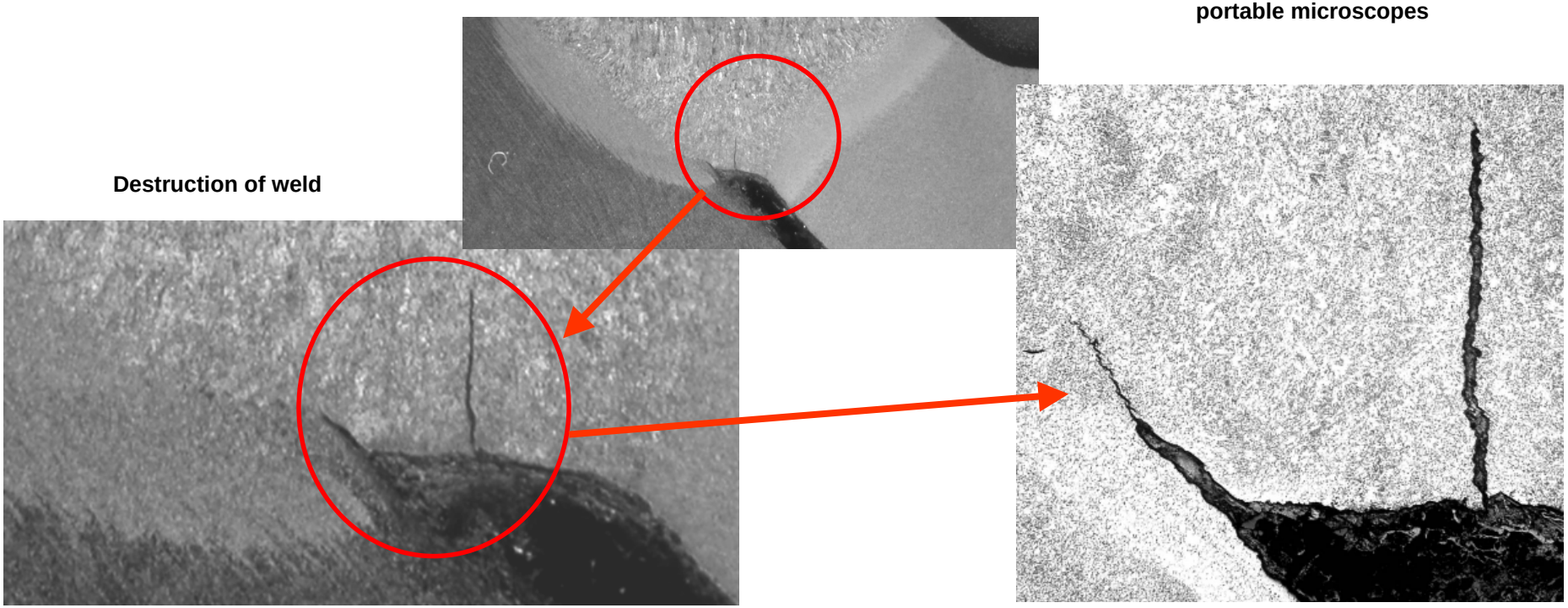
Scanniselectron microscope
(x 300 000 max)



Stereomicroscope "NIKON EPIPHOT TME"
(x 1 000 max)

Metallographic inspection of metal on working equipment using portable microscopes

Destruction of weld

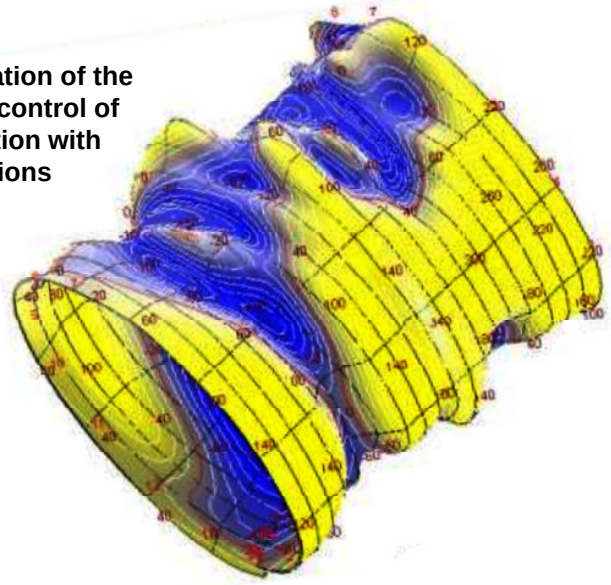


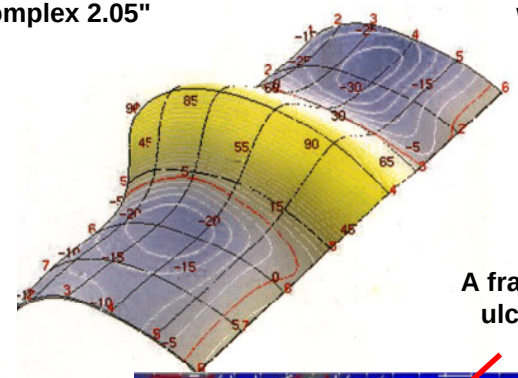
INVESTIGATION OF STRAINED AND DEFORMED STATES

Photo of magnet-anisotropic scanner-defectoscope "Complex 2.05" and the processing of inspection results

Implementation of the strain control of vessel model, working under pressure

Visual presentation of the results of the control of pipeline section with corrugations





Weld without defects

A fragment of shell with ulcer corrosion areas

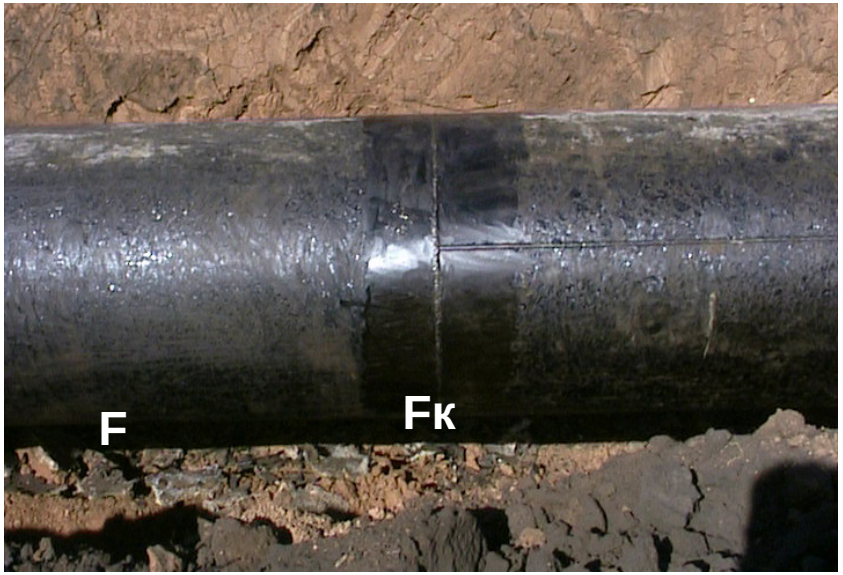
RELIABILITY OF RESULTS OF DIAGNOSIS

$$\{D\} = \{ h_{max}; V_o (V_{но})\}$$

h_{max}- the maximum deviation of the controlled setting

$V_o(V_{но})$ – probability of detection (no detection) deviations of the controlled parameters

Reasonable volume of selecting testing



F – total area of the pipeline surface;

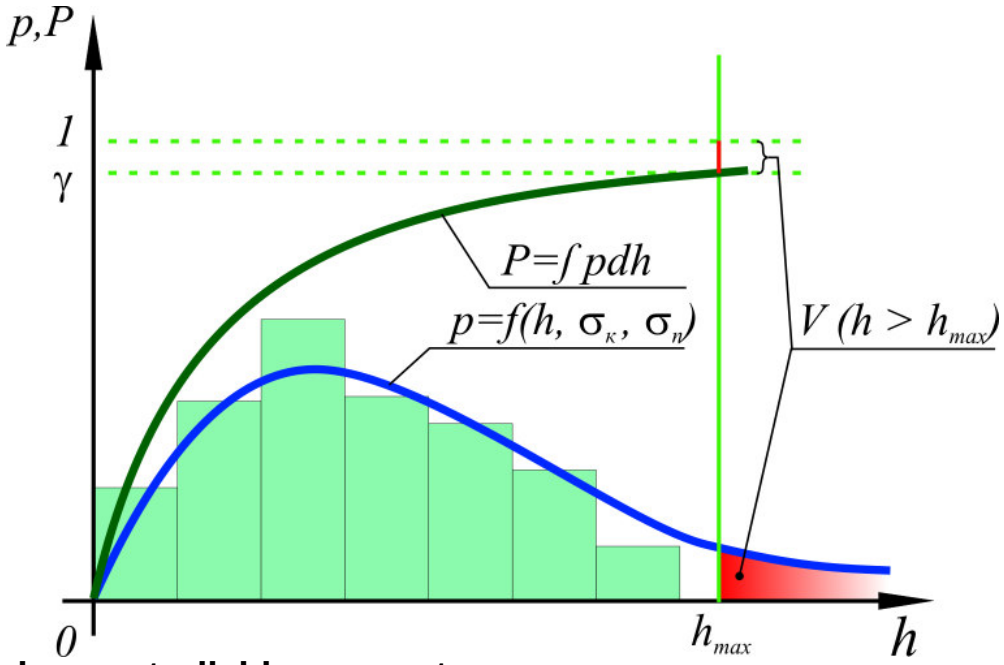
Fк – controlled area of the pipeline surface;

$\varepsilon=(F_к/F) \cdot 100\%$ - volume of selecting testing;

$V_o=[1-V\cdot(h>h_{max})] \cdot F_к/F$ $V_o \sim 1/ (\sigma_к; \sigma_п), \varepsilon;$

$V_{но}=1-V_o$; $V_{но} \sim \sigma_к; \sigma_п ; 1/\varepsilon$

The authenticity of testing



h – controllable parameter

p - density distribution h

P – probability function h

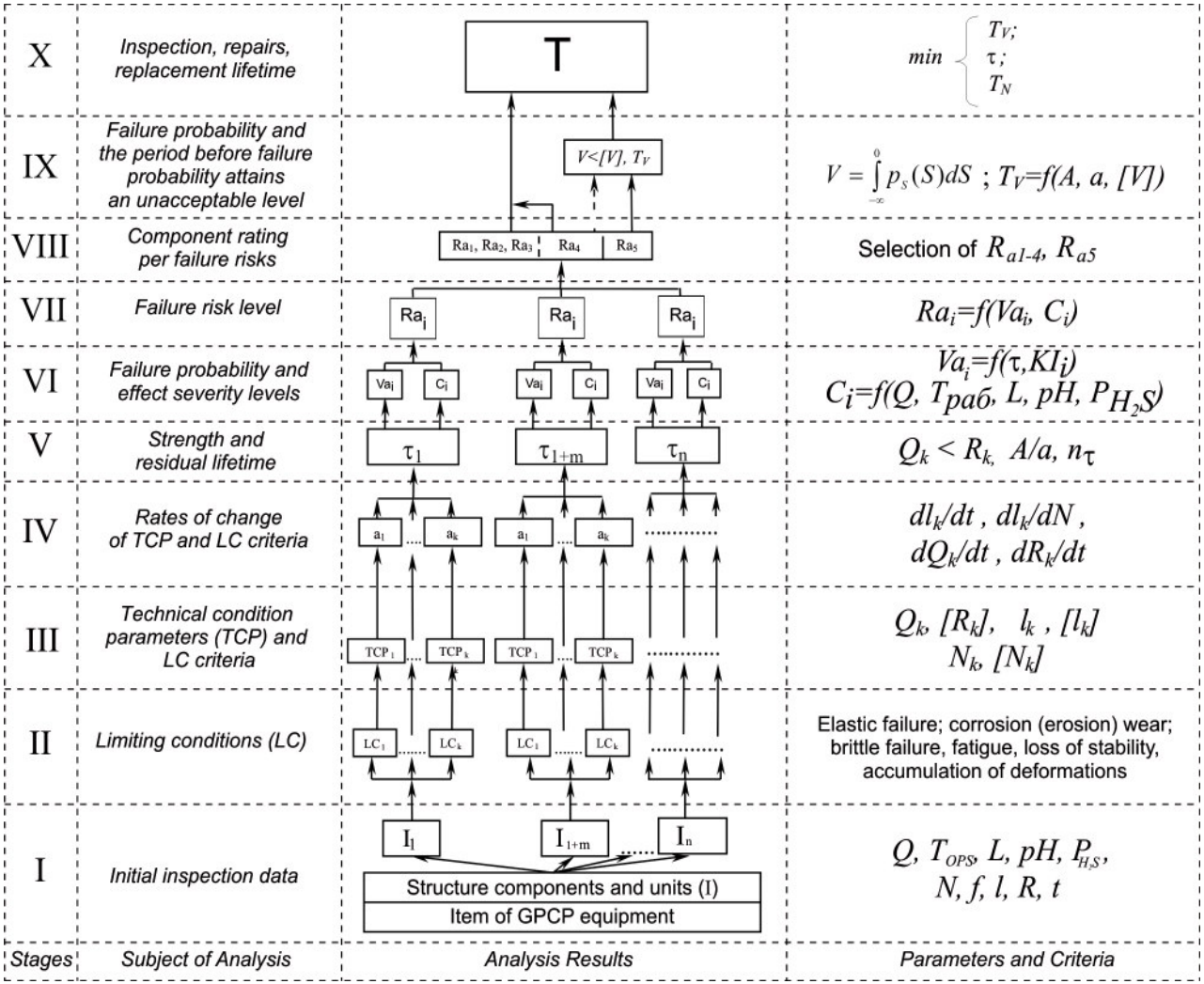
γ – trustee probability

V ($h>h_{max}$) – the probability of finding h outside the confidence interval

$\sigma_к$ – error of control

$\sigma_п$ – uneven damage

PHASES OF WORK, LIFETIME FORECASTING AND PLANNING INSPECTIONS OF GAS PROCESSING AND CHEMICAL TREATMENT EQUIPMENT BY HAZARD CRITERIA AND FAILURE PROBABILITIES



Q - generalized load;
T_{OPS} - operating temperature;
L - design;
pH, P_{H_2S} - operating environment characteristics;
N, f - generalized operating conditions;
l - generalized defect characteristics;
R - generalized load-carrying capacity;
t – non-failure period from the beginning of operation;
Q_k, $[R_k]$, l_k, $[l_k]$, N_k, $[N_k]$ – current values of technical condition and limiting condition parameters;
a = dl_k/dt, dl_k/dN, dQk/dt, dRk/dt - rate of change of technical condition parameters;
τ - predicted value of residual lifetime;
A - difference between technical condition and limiting condition parameter values;
Va_i – failure probability level;
KI_i - examination quality level;
C_i - failure effect severity level;
Ra_i - failure risk level;
V - failure probability;
$p_S(S)$ - safe-load factor probability density;
[V] - acceptable level of failure probability;
T_V - time to attainment of [V];
T_N - operating period between inspections;
n_N, n_V - safe-load factors;
T - specified time to inspection, repairs, replacement

COMPETENCE AND QUALIFICATION OF CENTRE OF CALCULATIONS AND EXPERIMENT PERSONNEL

Centre of calculations and experiment (CCE) in the structure of JSC "Tekhdiagnostica" executes (according to current technical documents) normative calculations for strength and the resources, as well as modelling behaviour of structures under the influence of external factors (pressure, temperature, vibration and other)

Personal of CCE periodically passes refresher courses and attested to perform calculations in strength by Russian technical supervision. Personnel of the CCE have 11 employers, including 4 specialists with experience of more than 6 years. Two specialists of the CCE have science degrees

In order to improve the reliability calculation models designs and quality of analysis their load capacity, survivability and longevity, CCE JSC "Tekhdiagnostica" contacts with the leading scientific research institutes in Russia: IMASH Russian Academy of Sciences (Moscow), South Ural State University (Chelyabinsk) and other.


УДОСТОВЕРЕНИЕ № 2006/2-7

Выдано ТАРАСОВУ АНДРЕЮ ВЛАДИМИРОВИЧУ

в том, что он аттестован в Центральной аттестационной комиссии Ростехнадзора России в качестве специалиста по расчетам на


Челябинский научный центр
Уральского отделения Российской Академии Наук

СВИДЕТЕЛЬСТВО
№ 004/2005

БАРЫШОВ Сергей Николаевич

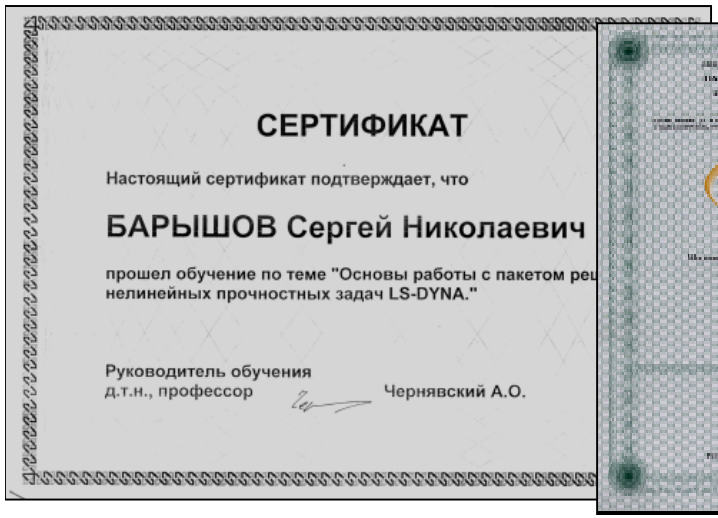
прошел в феврале 2005 года стажировку в Вузовско-академическом отделе проблем качества машин и аппаратуры по следующим направлениям:

- динамика машин и оборудования
- нормы и методы расчета на циклическую прочность оборудования и трубопроводов
- компьютерное моделирование деформирования и разрушения конструкций в аварийных ситуациях

и сдал экзамены по указанным курсам с оценкой "отлично".

Председатель ЧНЦ УрО РАН
член-корреспондент РАН /Л.П. Вяткин/

Руководитель отдела
доктор технических наук /Ю.Ф. Чернявский/


СЕРТИФИКАТ

Настоящий сертификат подтверждает, что

БАРЫШОВ Сергей Николаевич

прошел обучение по теме "Основы работы с пакетом рец нелинейных прочностных задач LS-DYNA."

Руководитель обучения
д.т.н., профессор Чернявский А.О.


"КОНСТРУКТОР"

УДОСТОВЕРЕНИЕ

Маньшину Анатолию Борисовичу


УДОСТОВЕРЕНИЕ

Настоящее удостоверение выдано инженеру

Лисовскому Олегу Николаевичу

в том, что он с «26» марта 2007 г. по «07» апреля 2007 г. прошел стажировку в отделе проблем качества в машиностроении Челябинского научного центра РАН по направлению «*Динамика, прочность и надежность конструкций (оборудование нефтегазовой и химической отрасли)*» в объеме *90 часов*

За время стажировки освоены следующие разделы:

Наименование	Кол-во часов
Нормы и методы расчета на статическую прочность оборудования и трубопроводов (рук. д.т.н. Чернявский О.Ф.)	20
Нормы и методы расчета на циклическую прочность оборудования и трубопроводов (рук. д.т.н. Чернявский О.Ф.)	20
Динамика машин и оборудования (рук. проф. Слива О.К.)	20
Программный комплекс решения инженерных задач прочности - ANSYS. Специальные темы (рук. д.т.н. Чернявский А.О.)	20
Компьютерное моделирование деформирования и разрушения конструкций в аварийных ситуациях (рук. д.т.н. Чернявский А.О.)	10

Руководитель отдела д.т.н., проф Чернявский О.Ф.

Председатель Челябинского научного центра РАН д.ф.-м.н., проф Кудинова Н.Д.

Город Челябинск «02» 04 2007 г.

Регистрационный номер

SOFTWARE

LSTC
Livermore Software Technology Corp.

Livermore Software Technology Corporation • 7374 Las Positas Road Livermore, CA 94551
Telephone: (925) 449-2500 • Fax: (925) 449-2507 • Website: www.lstc.com

CERTIFICATION

JSC "Tekhdiagnostika", Orenburg, Russia in the name of A. Vdowin is the licensed user of LS-DYNA (v.970, Commercial) and has a right to use these Products (software application programs and the associated documentation, developed and marketed by LSTC) for commercial purposes without any time limits.

John O. Hallquist
President
Date: 1 July 2005

Corp. Seal 1987

Structural Research & Analysis Corporation
Product Authorization/Maintenance Information

Version and Build	:	COSMOSM GeoStar V2.60 (28002 - 2003/095)
Customer Name	:	STC CONSTRUCTOR-TECHDIAGNOSTIKA C STRUC
License Expiration Date	:	11-jun-0
Maintenance Number	:	NONE
Maintenance Expiration Date	:	11-jun-2003
Maximum Node Limit	:	256000
License id	:	0611200358074851

LSTC
Livermore Software Technology Corp.

COSMOS/M
A COMPLETE FINITE ELEMENT ANALYSIS SYSTEM

In order to perform calculations on the strength and residual resource of equipment and pipelines, modelling behaviour of structures under the influence of external factors Centre of calculations and experiment (CCE) of JSC "Tekhdiagnostica" applies only certified software, such as:

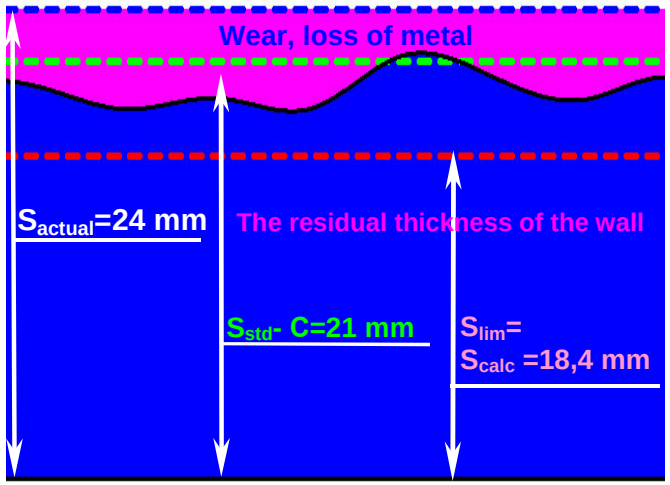
- LS-Dyna (Livermore Software Technology Corporation);
- Cosmos/M (Structural Research & Analysis Corp.);
- PVP-Design.

STRENGTH CALCULATION

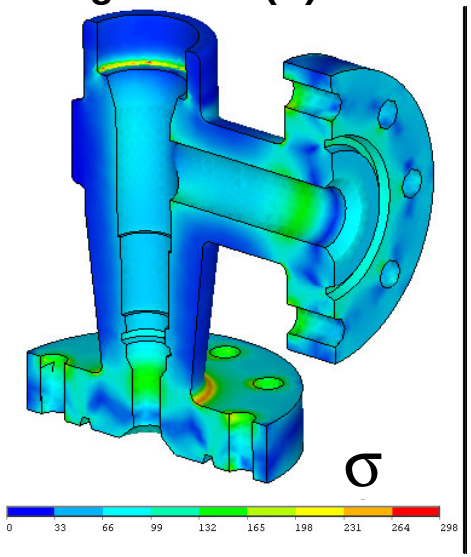
$$Q_{\max} \le [\Phi]_n$$

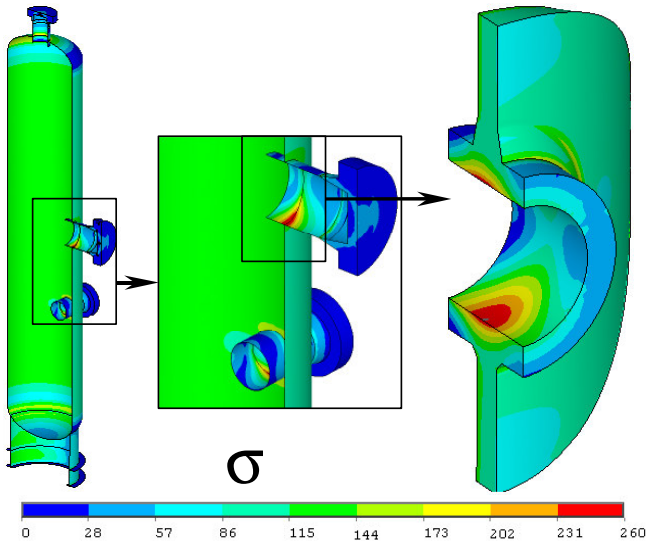
$$\frac{P^{Э}_{\max}}{\delta(D)} = \{\sigma_1;\sigma_{ЭКВ};\sigma_a;K_1;....\} = Q_{\max} \le [\Phi]_n = \frac{\Phi}{n} = \left\{\frac{\sigma_T}{n_T};\frac{\sigma_B}{n_B};\frac{\sigma_a}{n_a};\frac{K_{1C}}{n_K};.....\right\}$$

Q – common load characteristic; Φ – common characteristic of load capacity (by criteria of a limiting state (LS)); $[\Phi]_n$ – regulatory criteria permissible values LS; $P^{Э}$ – operational parameters of loading; δ(D) –parameters of TC by the results of diagnostics (D)



Limiting (outdrop) thickness of the wall

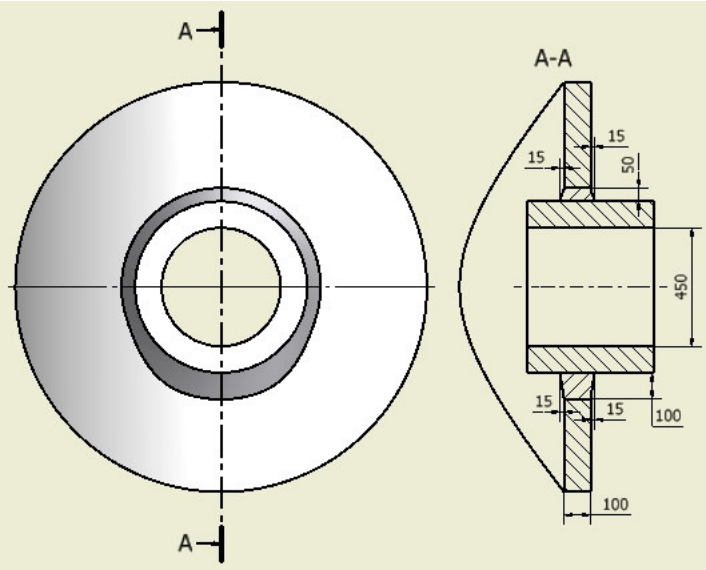




The calculation and analysis of SDS fixtures, units and components

- **rated calculations to determine the regulatory limit (outdrop) thicknesses of the equipment walls**
- **calculations for static, cyclic (fatigue), strength, resistance to brittle fracture, stability, etc.**
- **calculations of strain-deformed state (SDS), according with results of the survey - the actual geometry, damage, the system loads and impacts;**
- **calculations for limiting, and destroying critical loads and impacts**

EVALUATION AND CALCULATION OF STRESS IN CHOKE ASSEMBLY WITH VIOLATION OF WELD JOINT GEOMETRY



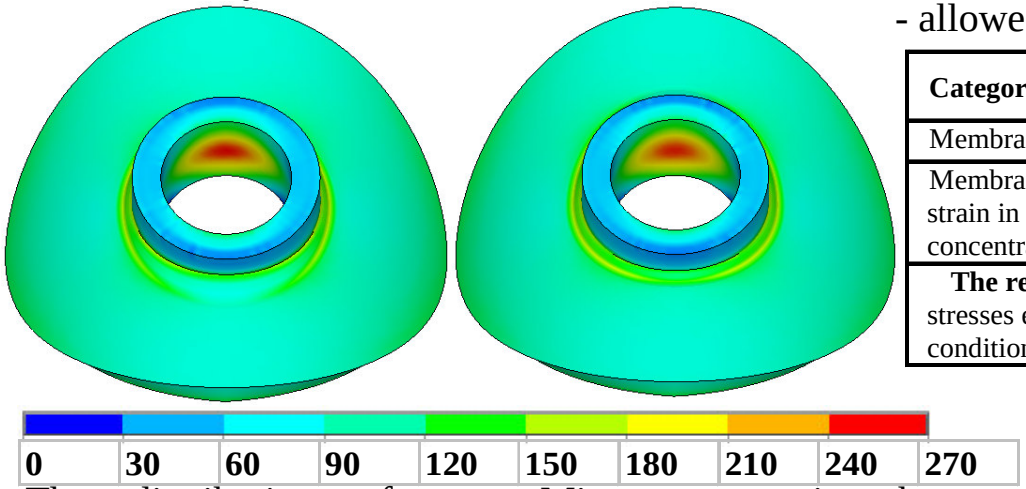
The estimated model and symbol basic geometric parameters junction box connections "P" in the body of vessel

At vessel "C-401A" established at UKPG-3 Karachaganak Petroleum Operating b.v., found a discrepancy of shape and size of a welded seam welding neck of connection node “P" (hatch-hole) in the body of the vessel.

Baseline data for the calculation:

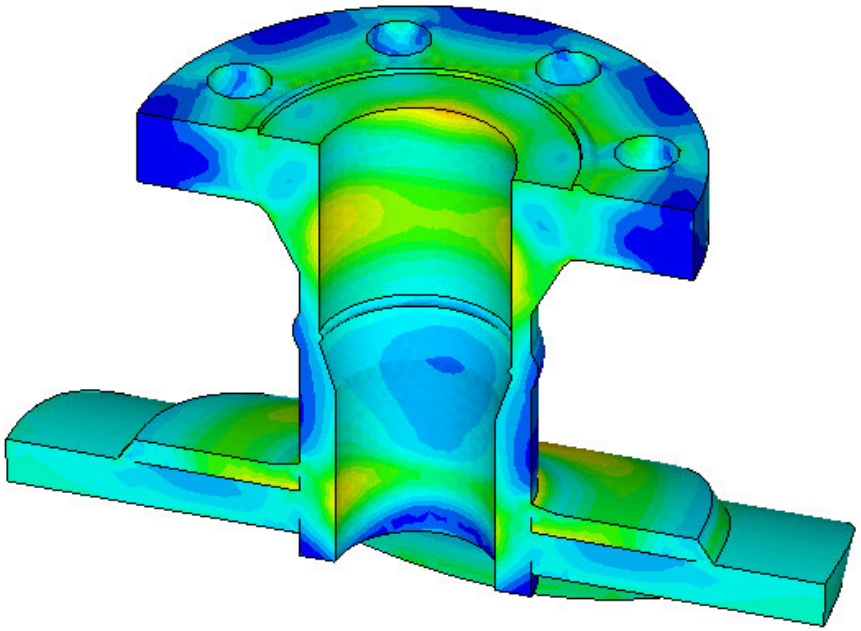
- external diameter of shell – 1600 mm;
- conditional diameter of branch pipe – 450 mm;
- rated pressure – 14,3 MPa;
- material of shell – Steel 20JCH;
- material of branch pipe – Steel 20JCH;
- yield strength [σ]т=235,0 MPa;
- tensile strength [σ]B=410,0 MPa
- allowed strain [σ]=129,0 MPa.

Category of strain	Rated pressure, Mpa	Allowed value, MPa
Membrane	160	$1{,}3\cdot[\sigma]=167$
Membrane + branch + local strain in the light of concentration	270	$\sigma_B=410$
The results of calculations and analyses of SDS show, what the level of stresses encountered in the design was acceptable for normal operating conditions		



The distribution of von Mises stress in the connection node from the pressure (color distribution - meaning stresses in the MPa)

EVALUATION AND CALCULATION OF STRESS IN CHOKE ASSEMBLY WITH DEFECTS IN WELD JOINTS



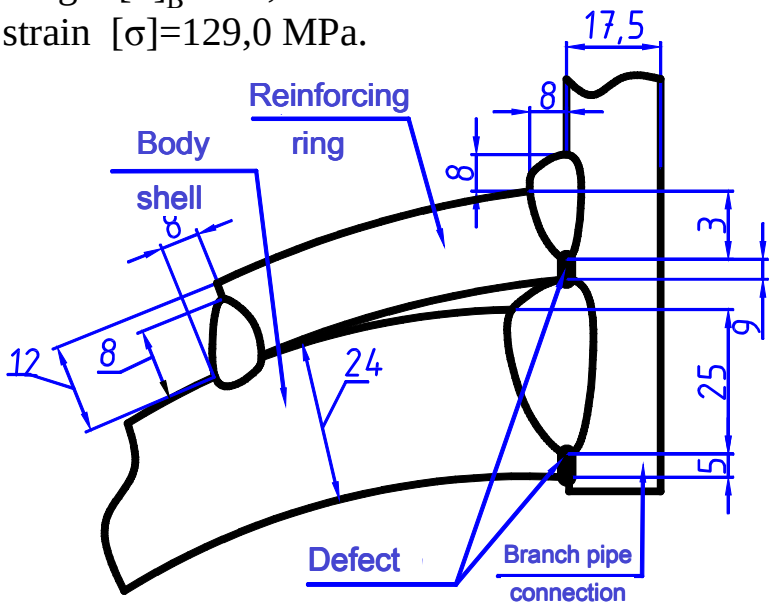
The distribution of von Mises stress in the connection node from the pressure (color distribution - meaning stresses in the MPa)

In vessel "Buffer capacity pumping 2-nd stage" established at the gas processing plant of the "Gazprom Dobycha Astrakhan" LLC, revealed a defect in the weld seams welding pipe connections in the body of the vessel and welding reinforcing ring to the branch pipe connections.

Baseline data for the calculation :

- external diameter of shell – 350 mm;
- external diameter of branch pipe – 128 mm;
- rated pressure – 10,0 MPa;
- material of body – Steel 20;
- material of branch pipe – Steel 20;
- yield strength $[\sigma]_T$=210,0 MPa;
- tensile strength $[\sigma]_B$=410,0 MPa
- allowed strain [σ]=129,0 MPa.

Category of strain	Rated pressure, MPa	Allowed value, MPa
Membrane	140	$1{,}3 \cdot [\sigma] = 167$
Membrane + branch + local strain in the light of concentration	213	$\sigma_B = 410$
The results of calculations and analyses of SDS show, what the level of stresses encountered in the design was acceptable for normal operating conditions		



CONCLUSIONS

This submissions describes JSC "Tekhdiagnostica" as scientific, research and production enterprise, which can offer its customers not only the quality and operational non-destructive testing, but innovation in the domain of industrial safety, reliability and uninterrupted operation of the equipment, failure probability calculations, predicting failure effect severity and risk analysis refusal.

Proof of a high standard of quality in works, performed by JSC "Tekhdiagnostica", are the obtaining licenses and accreditations, competence of personell, instrumentation, metrology and methodological provision, many years of experience in dealing with largest potentially hazardous production facilities - "Gazprom Dobycha Orenburg" LLC, "Gazprom Dobycha Astrakhan" LLC, Karachaganak Petroleum Operating B.V. and other.

JSC "Tekhdiagnostica" has dozens of gratitude and positive feedbacks from customers as well as from oversight bodies on industrial safety.

As the organisation of independent experts, JSC "Tekhdiagnostica" is offering its services to inspect process equipment in gas, oil, petrochemical and other industries anytime, anywhere, in any volumes, and at a moderate price.

Our goal is to lower accidental risks and failure hazards. Cooperation with our company will guarantee high quality of works at a minimal cost.

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