

# THE ABILITY TO DEFECT OF STRESS CORROSION DEFECTS IN THE MAIN GAS PIPELINE AND CONDITIONS FOR THEIR DEVELOPMENT

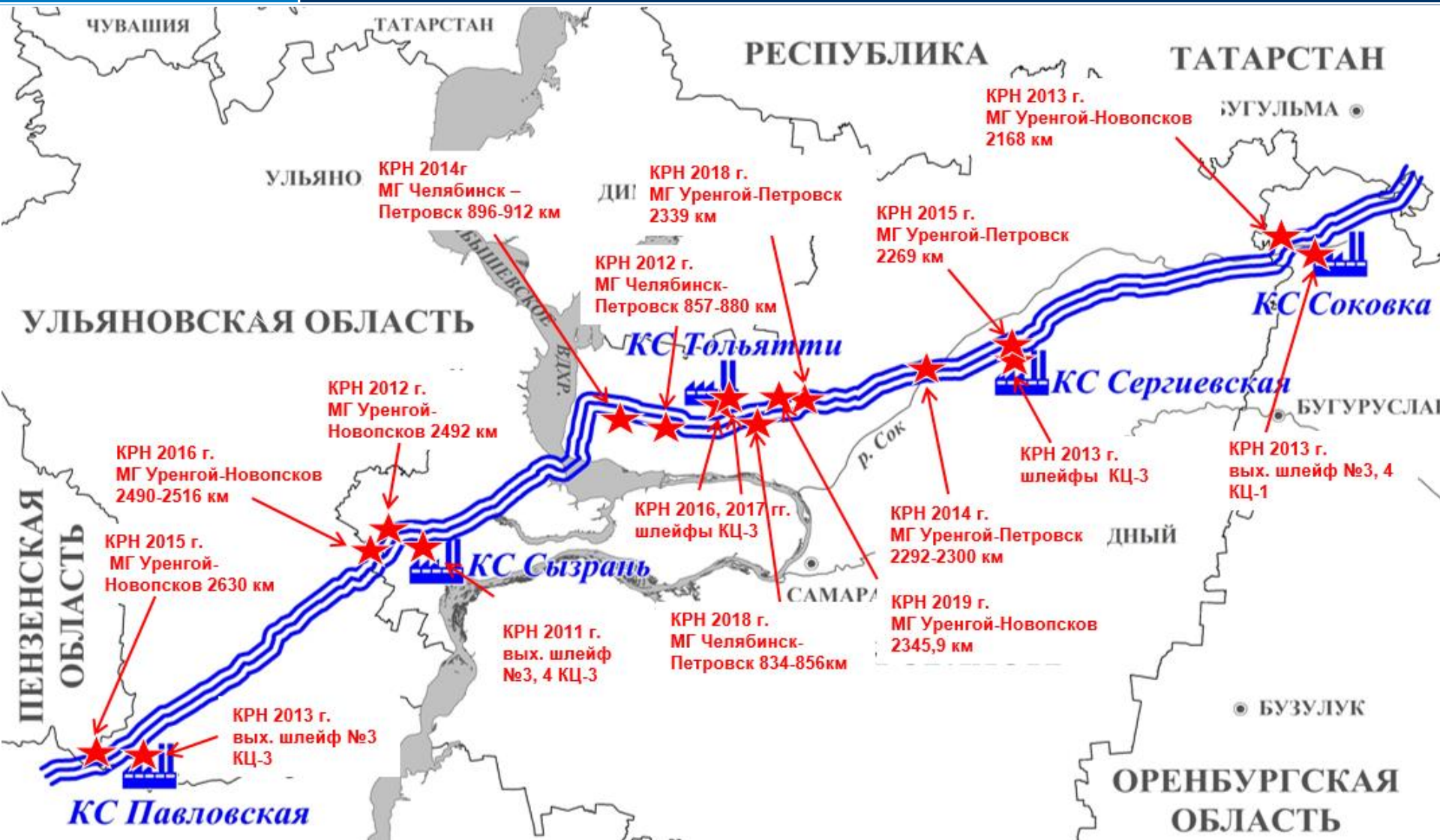
Komarov Dmitry Valerievich

Lead Engineer of Technical Condition and ETC (Engineering and  
Technical Center) Consistency Management OOO Gazprom transgaz  
Samara

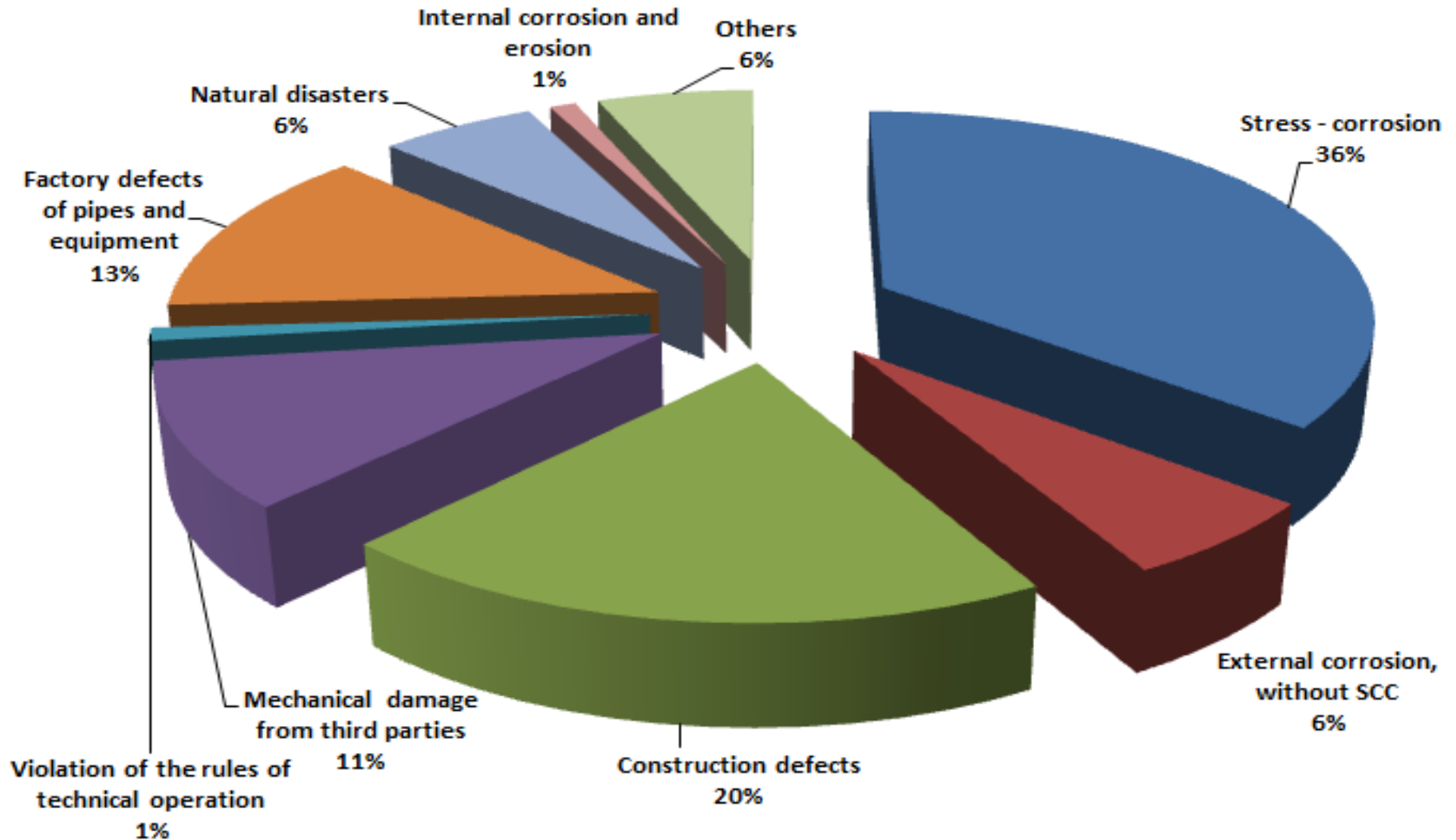
Antipov Sergey Vasilievich

Engineer of 1 category of Technical Condition and ETC (Engineering  
and Technical Center) Consistency Management OOO Gazprom  
transgaz Samara

# Areas with corrosion cracks identified in OOO Gazprom transgaz Samara as of early 2020



# Causes of accidents at the elements of the gas transmission system of Gazprom



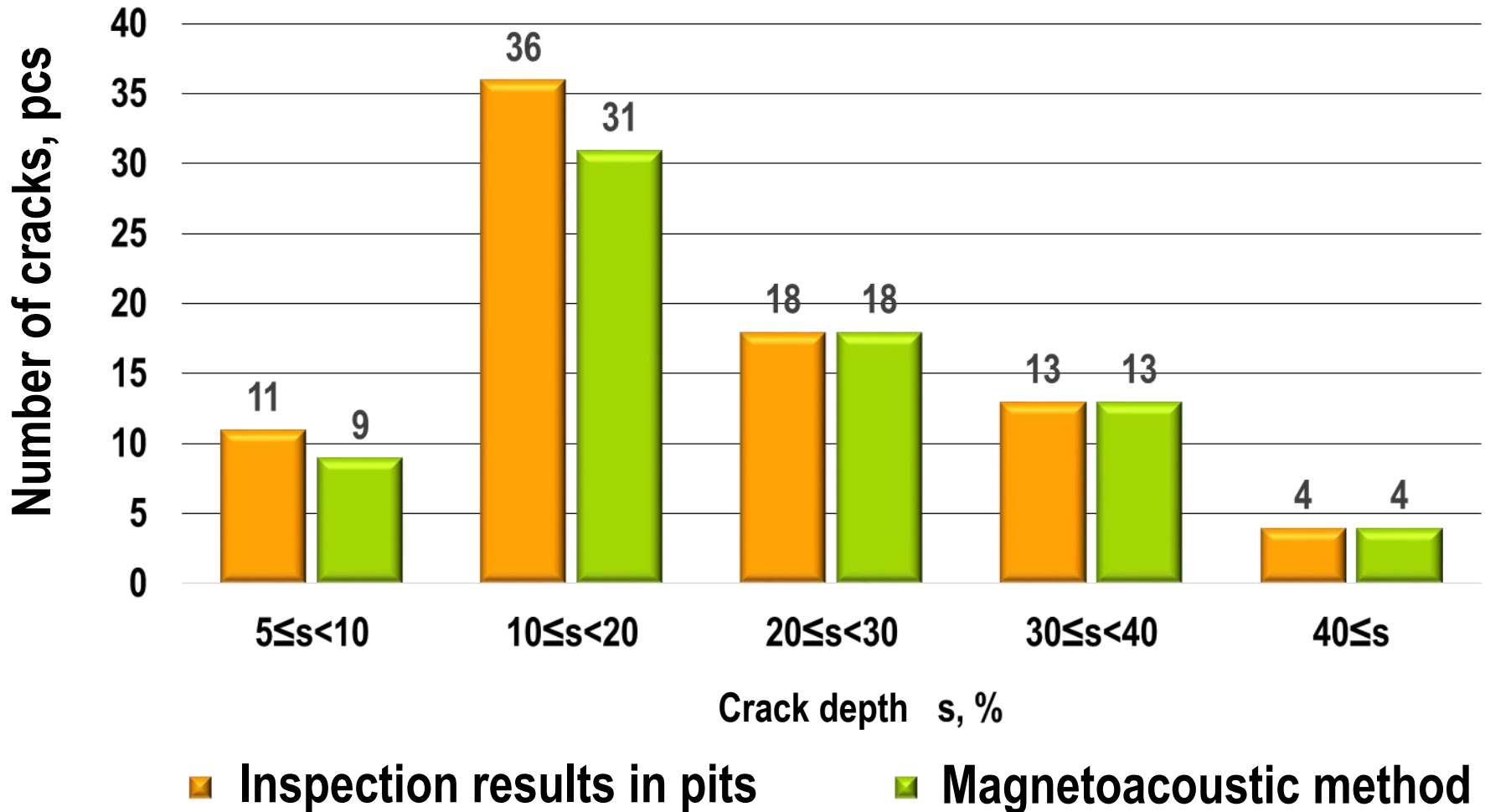
**A pit 35 × 11 m in size and up to 4.5 m deep was formed at the accident site.**

**As a result of the accident, a 26.5 m section of the gas pipeline was destroyed, with the release of two fragments of double-seam pipes.**

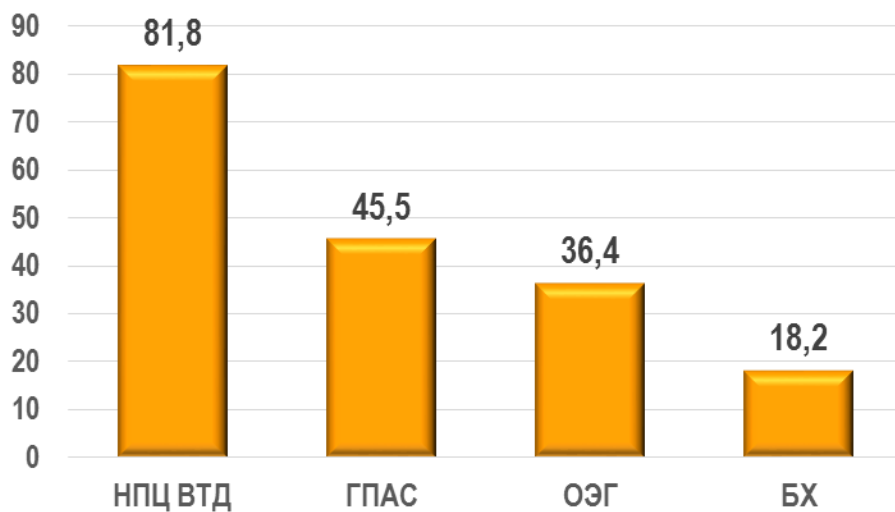


**The cause of the accident was the SCC defect located on the pipe of the Khartsizskiy pipe plant 1420 × 15.7 mm, manufactured in 1982, according to TU 14-3-995-81, from steel grade X70.**



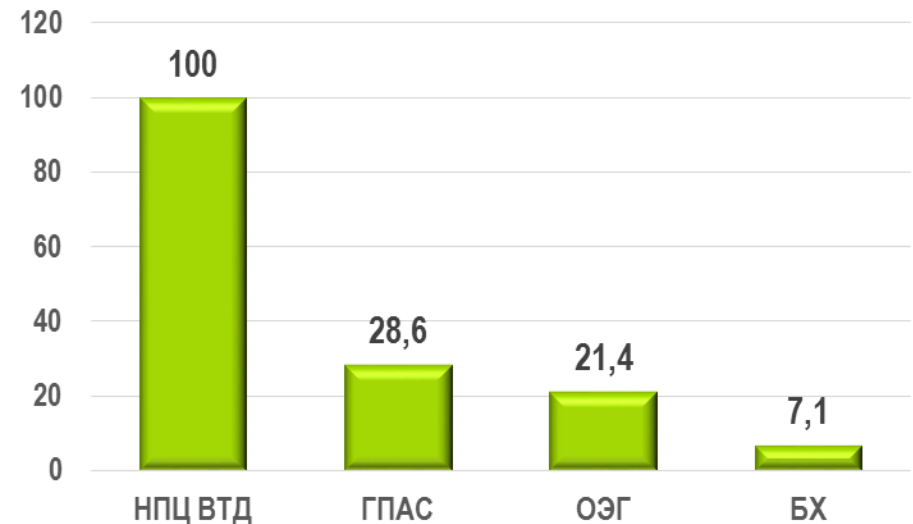


## Detection of defects with a depth of 15-20% of the wall thickness



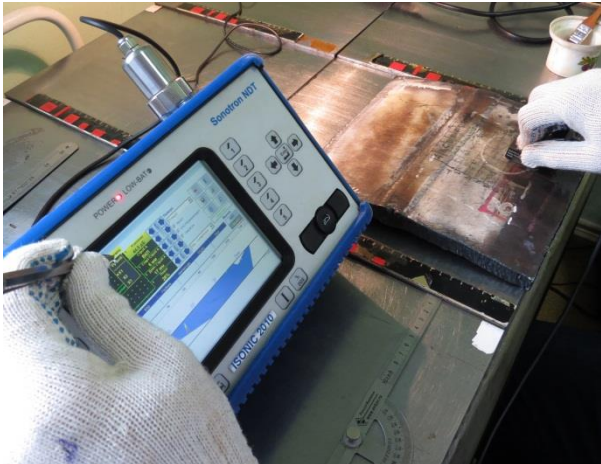
Contracting diagnostic organization

## Detection of defects with a depth of 26-50% of the wall thickness

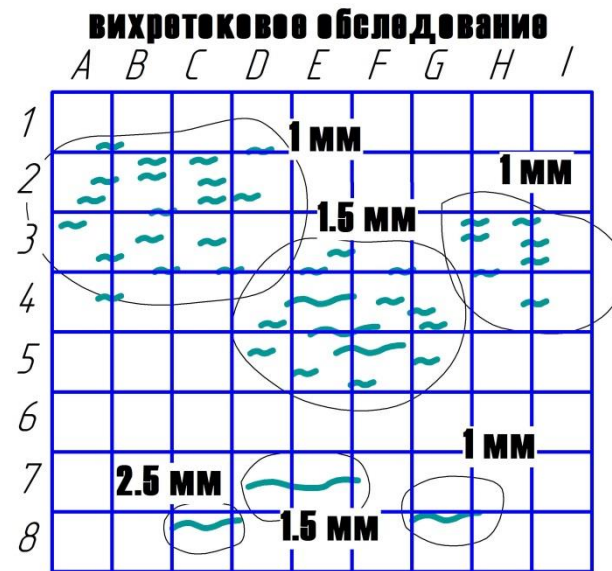
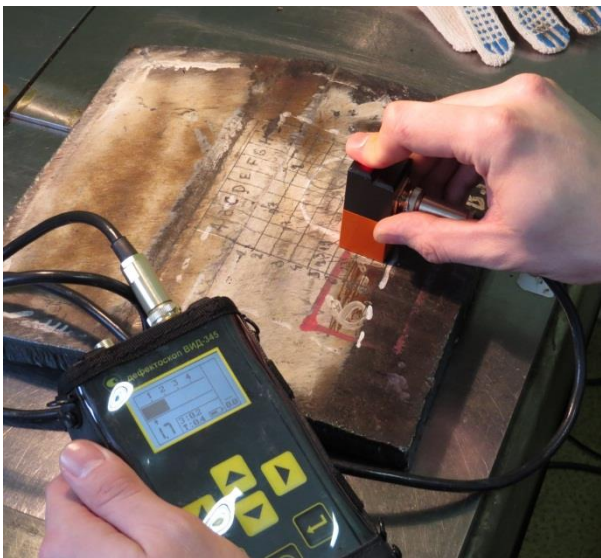


Contracting diagnostic organization

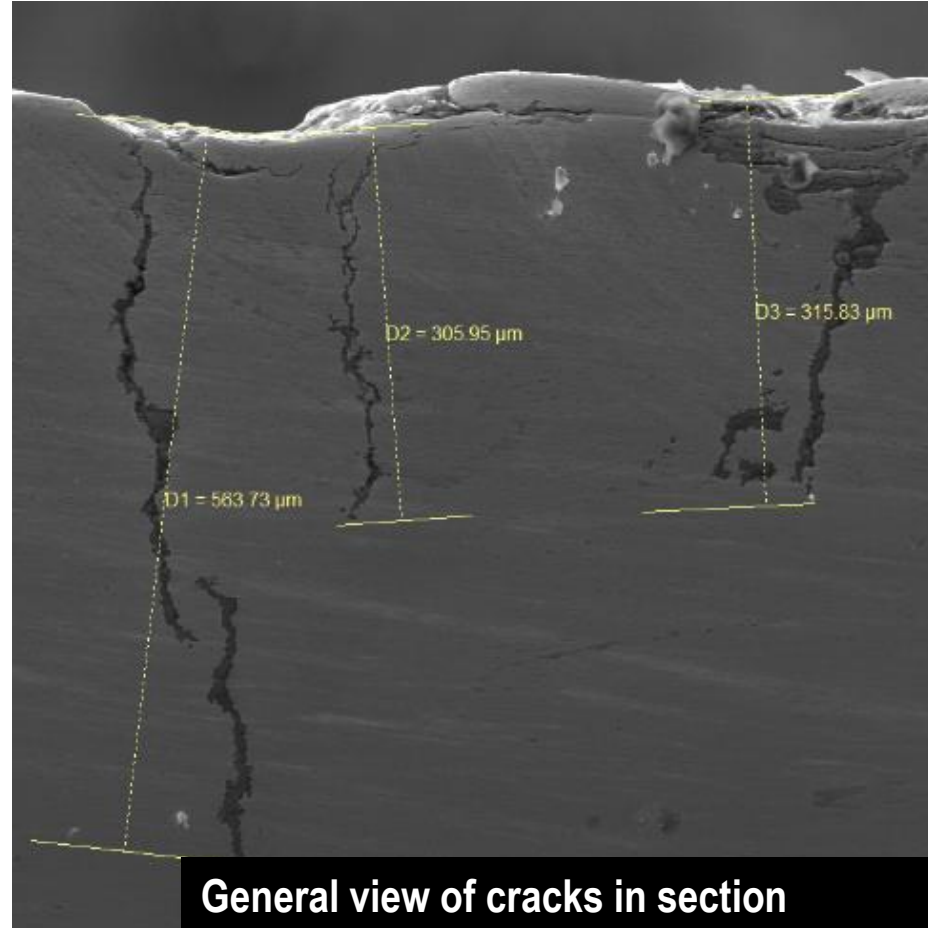
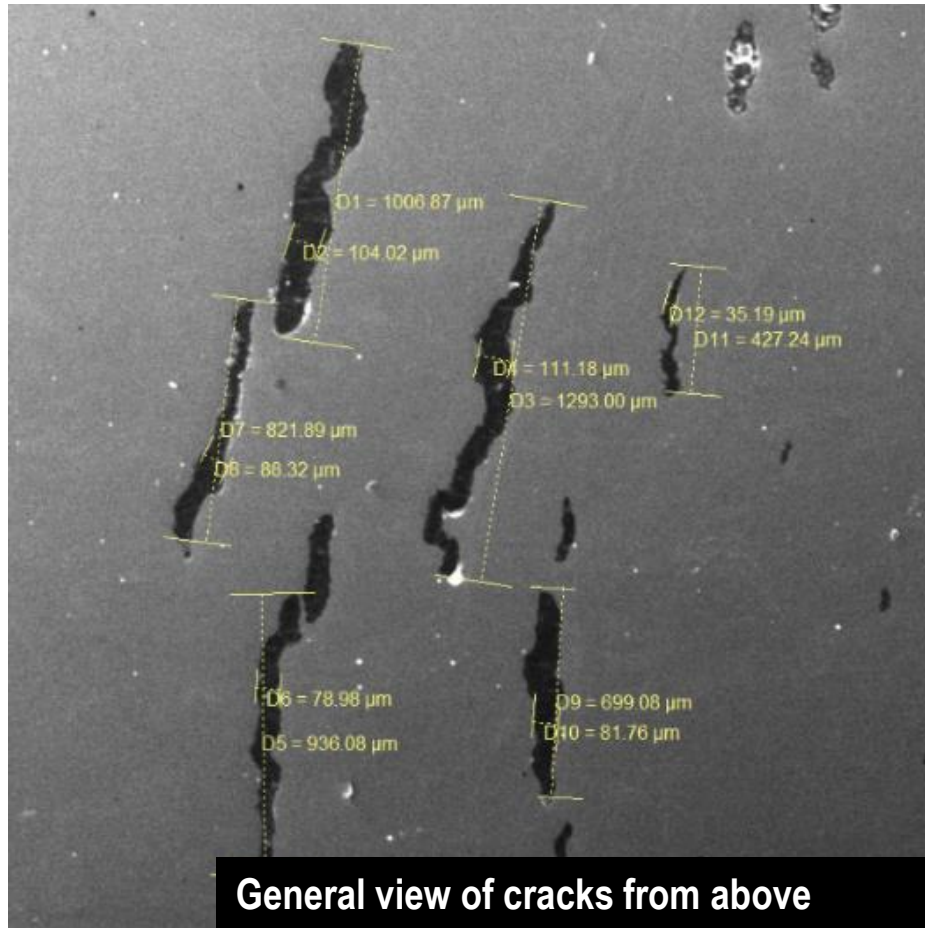
- НПЦ ВТД – ООО «НПЦ «ВТД»;
- ГПАС – АО «Газприборавтоматикасервис»;
- ОЭГ – АО «Газпром оргэнергогаз» филиал «Саратоворгдиагностика»;
- БХ – АО "Бейкер Хьюз Технологии и Трубопроводный Сервис"



The problem of assessing the depth of cracks of small opening by various methods of non-destructive testing is one of the most urgent in pipeline diagnostics.

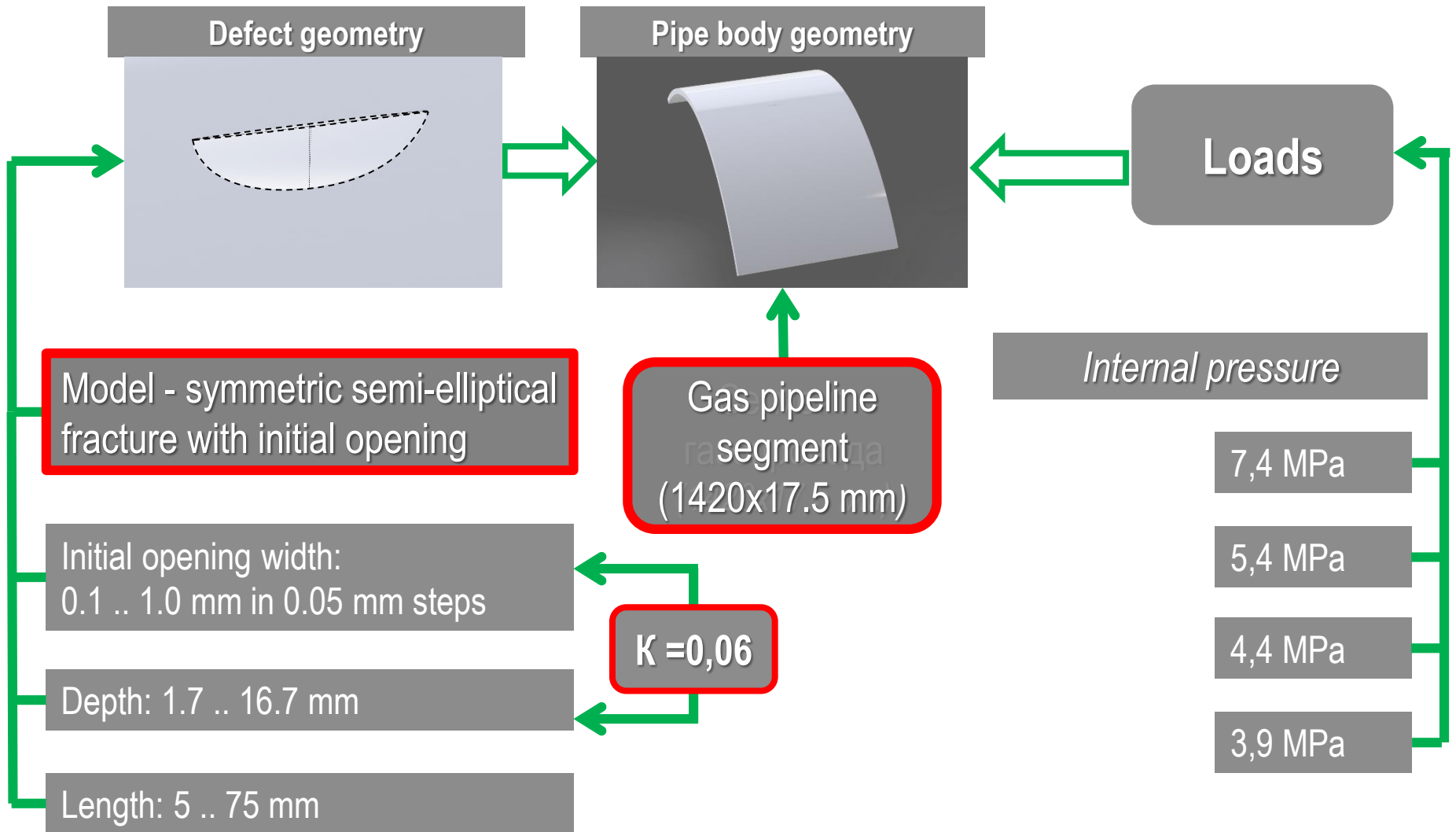


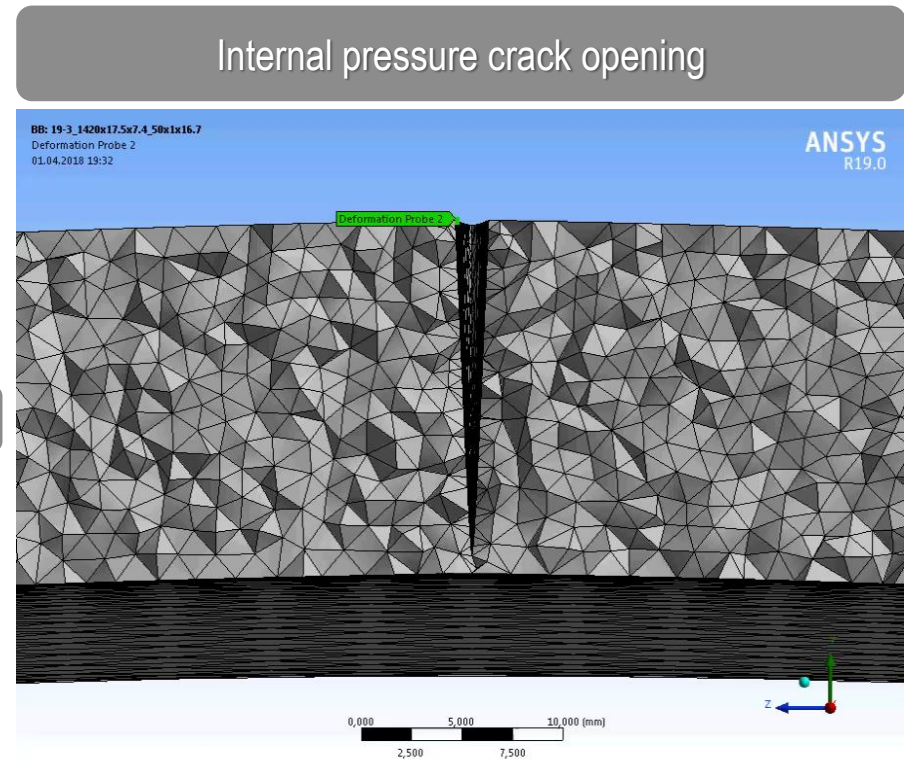
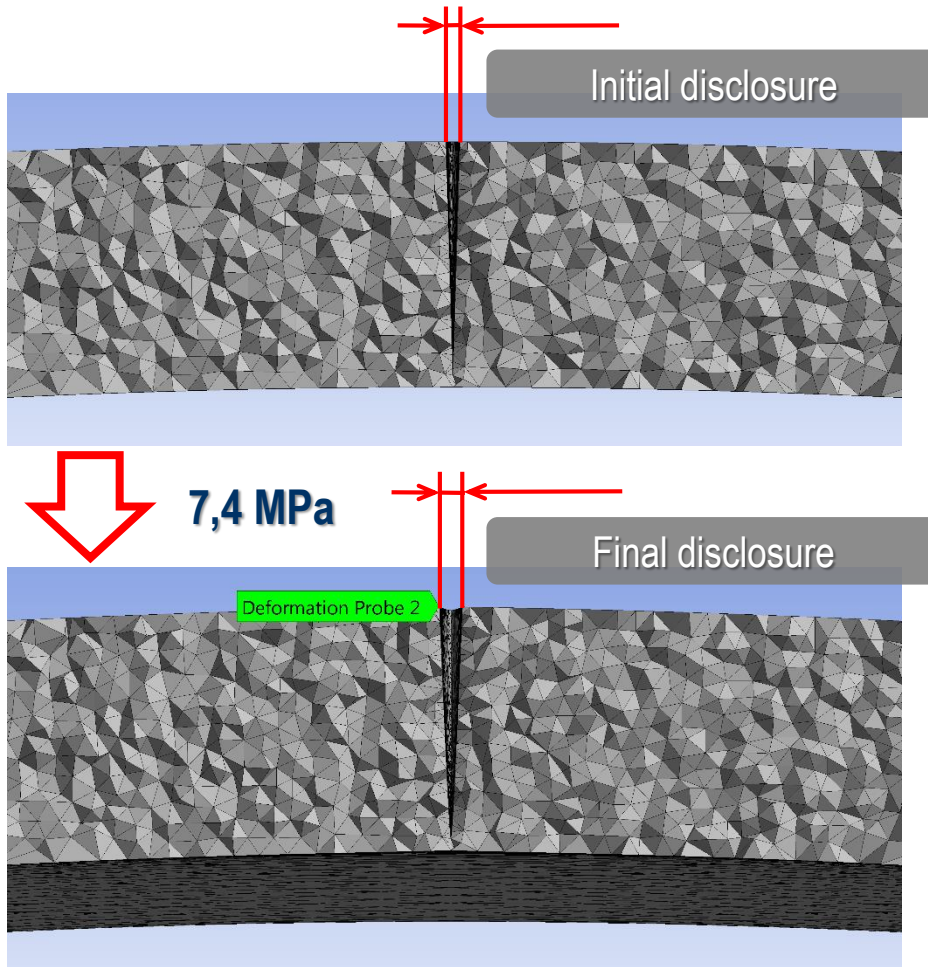
# Method for assessing the main external parameters of stress-corrosion cracks by direct measurement





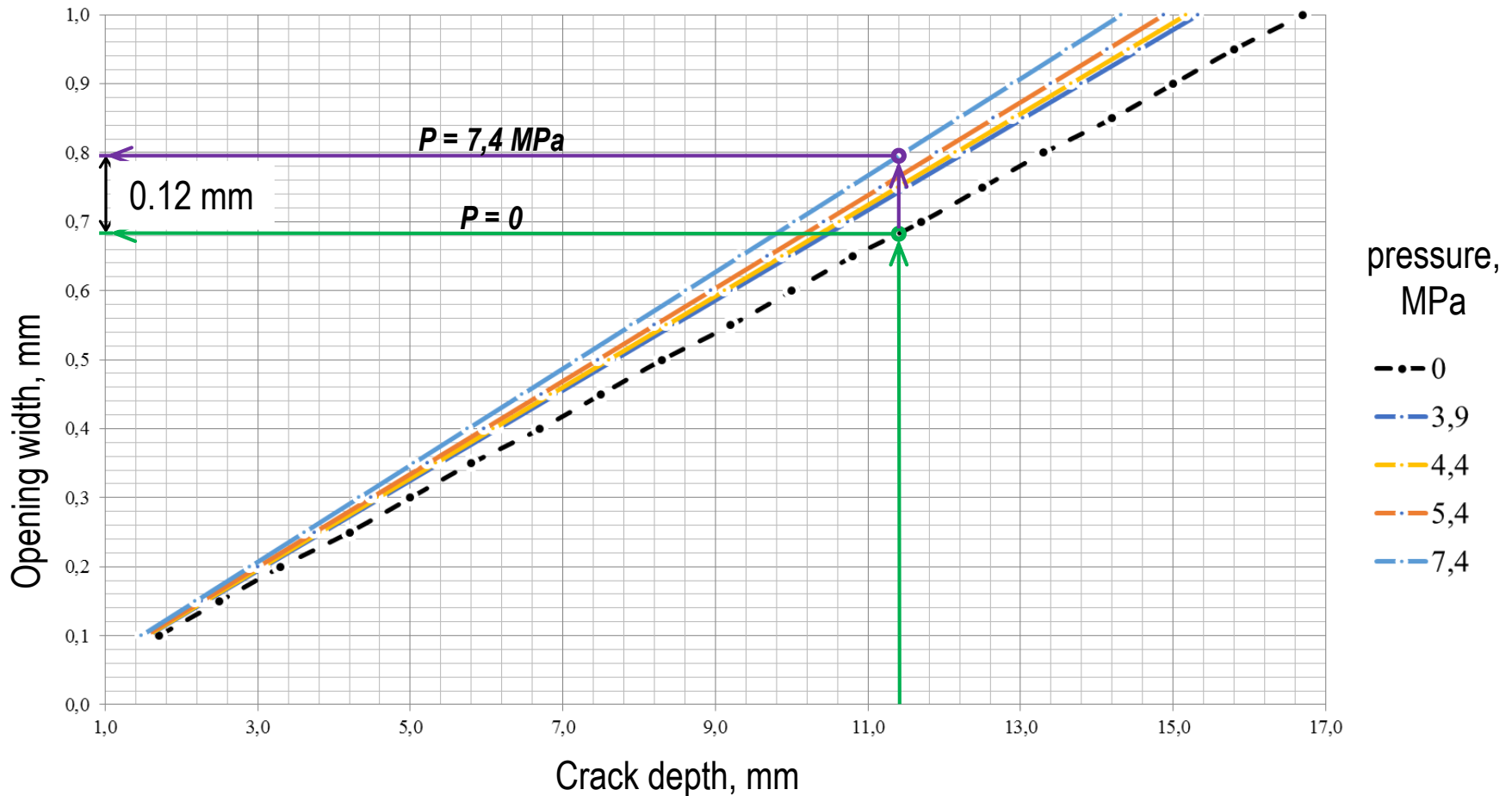
# Boundary conditions of numerical experiments for modeling stress-corrosion cracks in the Ansys program





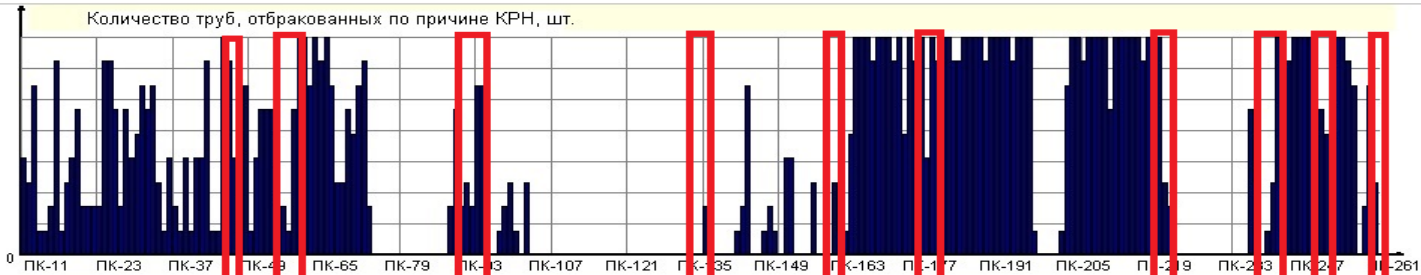
Масштаб визуализации – x4

## Dependence of the crack opening width on its depth (crack length - 50 mm)

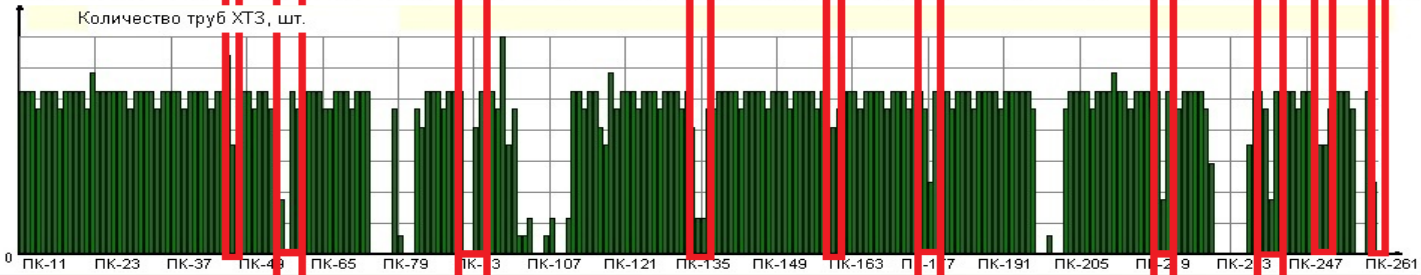


# Comparison of pipes rejected due to SCC at the KR section of MGP of OOO Gazprom transgaz Samara DN1400 with various factors

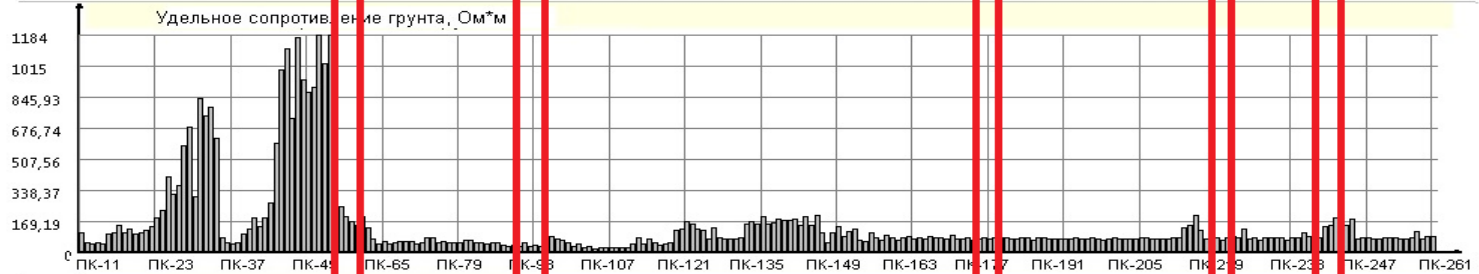
The number of pipes rejected due to SCC



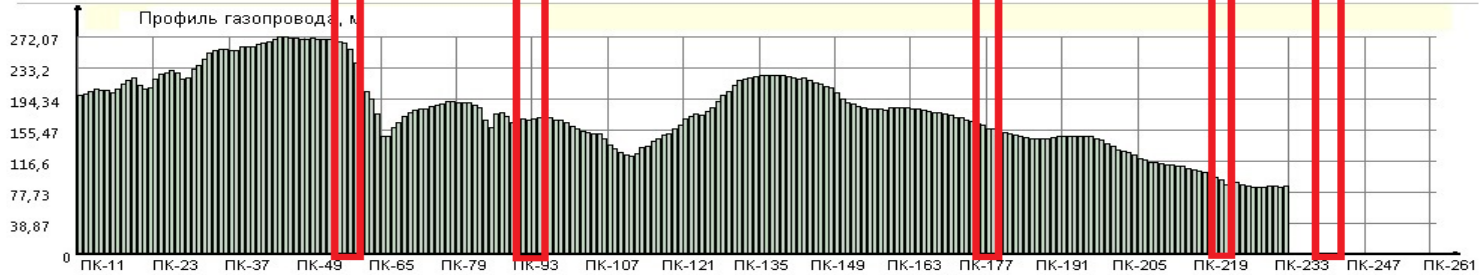
Number of pipes of Khartsyzskiy pipe plant



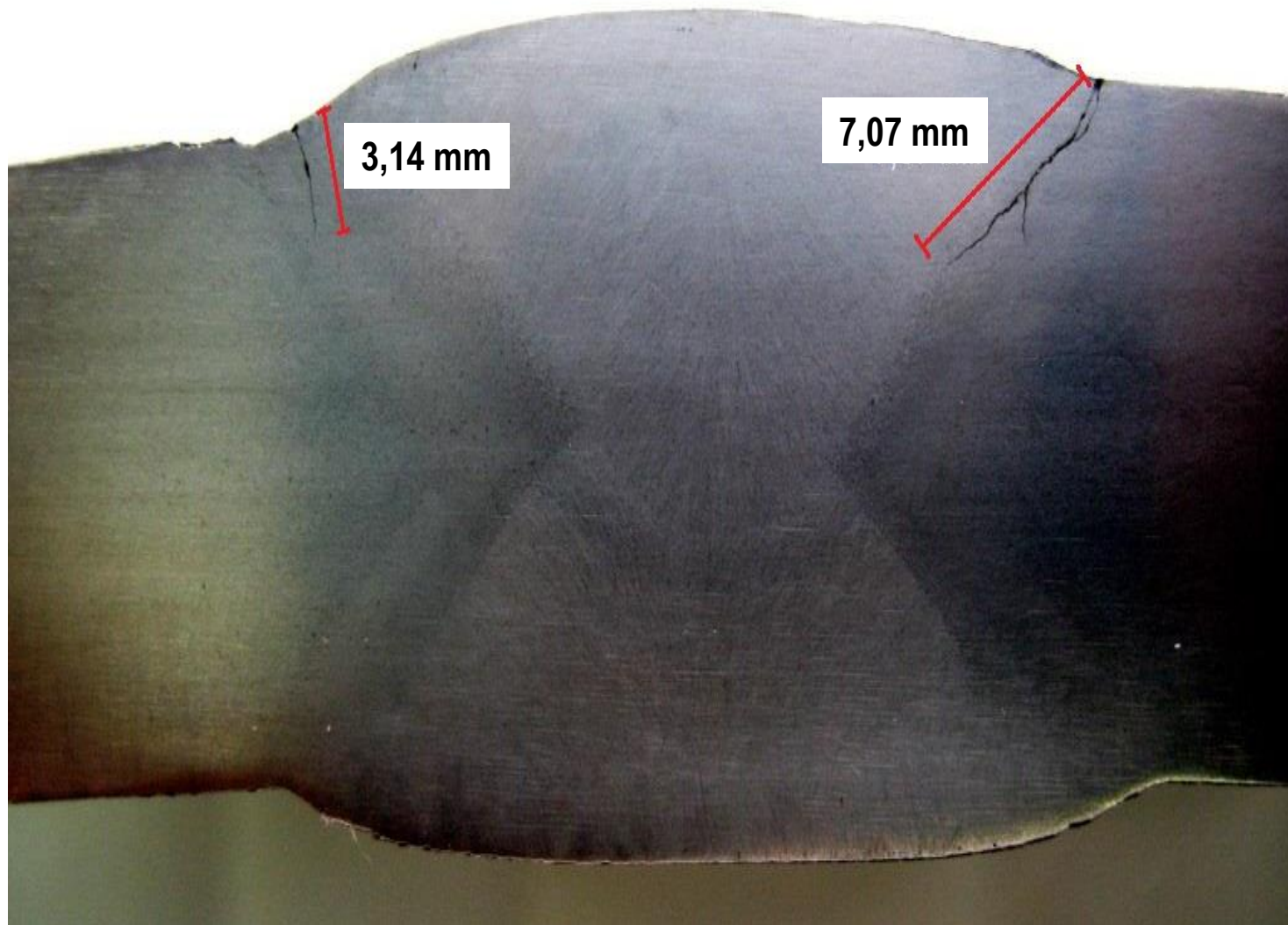
Soil resistivity



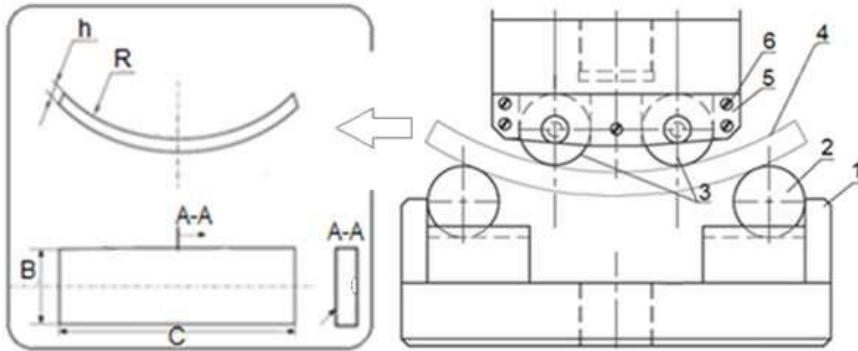
Gas pipeline profile



# SCC in the heat-affected zone of the longitudinal factory seam of the two-seam pipe of the Khartsyzsk pipe plant



# Cyclic tests of samples cut from pipes of the outlet loop of the compressor station of OOO Gazprom transgaz Samara with SCC defects



R - pipe radius;  
h - wall thickness;  
B - sample width;  
C - sample length

1 - lower support;  
2 - lower support rollers;  
3 - upper support rollers;  
4 - test sample;  
5 - upper support;  
6 - spacers

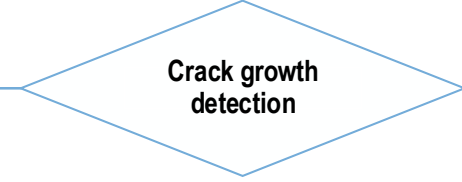


Sample cleaning and preparation. Making a metallographic image of a crack on the lateral surface of a thin section

Installation of the sample into the grips of the testing machine. Setting the load  $0.1\sigma_t$ . Fixing  $h_0$  and  $F_0$  at the top and bottom points

Implementation of 640 cycles. Fixation of H and  $\Delta F$  every  $N = 50$  cycles at the top and bottom points

Making a metallographic image of cracks on the lateral surface of a thin section



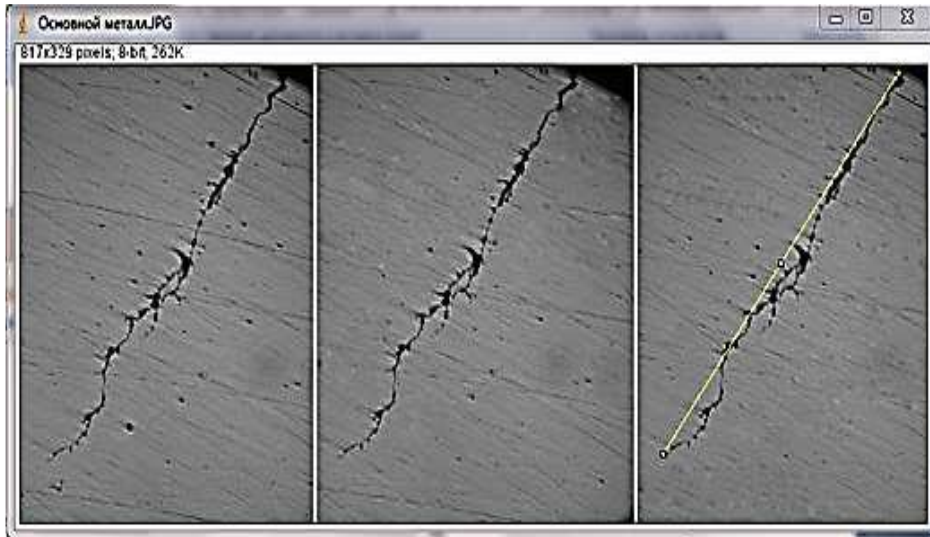
Stop testing. Parameter recording

Continuation of the test

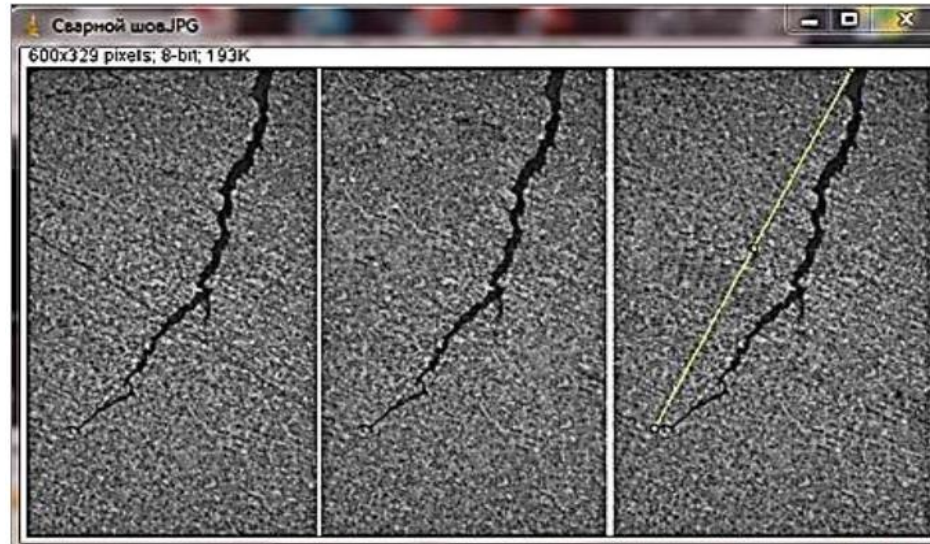
Making a metallographic image of cracks on the lateral surface of a thin section

Analysis of test results

# Monitoring the state of stress-corrosion cracks during cyclic testing of samples



Results			
File	Edt	Font	Results
	Mean	Angle	Length
1	116.487	-127.035	347.001
2	110.040	-127.569	344.426
3	113.190	-127.730	346.439



Results			
File	Edt	Font	Results
	Mean	Angle	Length
1	106.151	-117.282	286.021
2	104.792	-117.196	284.890
3	105.432	-117.375	285.118

# Determination of the endurance limit of pipe material with SCC defects up to 15% of the pipe wall

**View of destroyed specimens after fatigue tests on the UMP-01 installation**

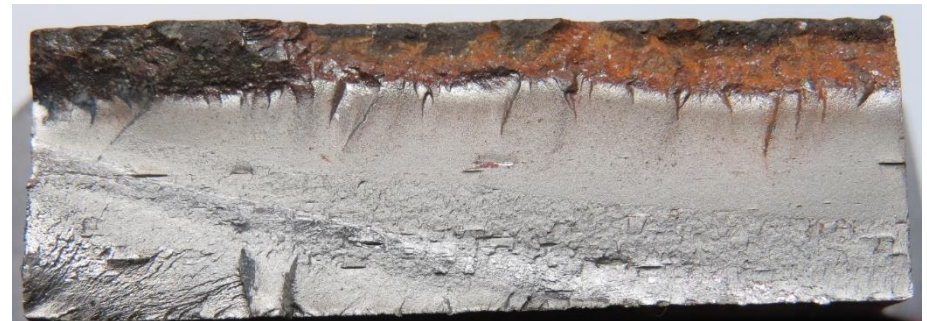


Fatigue tests were carried out according to the scheme of cyclic symmetric transverse bending in one plane on universal testing machines UMM-01 with a vibration frequency  $f = 30.8$  Hz and UMP-01 with a frequency  $f = 17.6$  Hz

**View of destroyed specimens after fatigue tests on the UMM-01 installation**



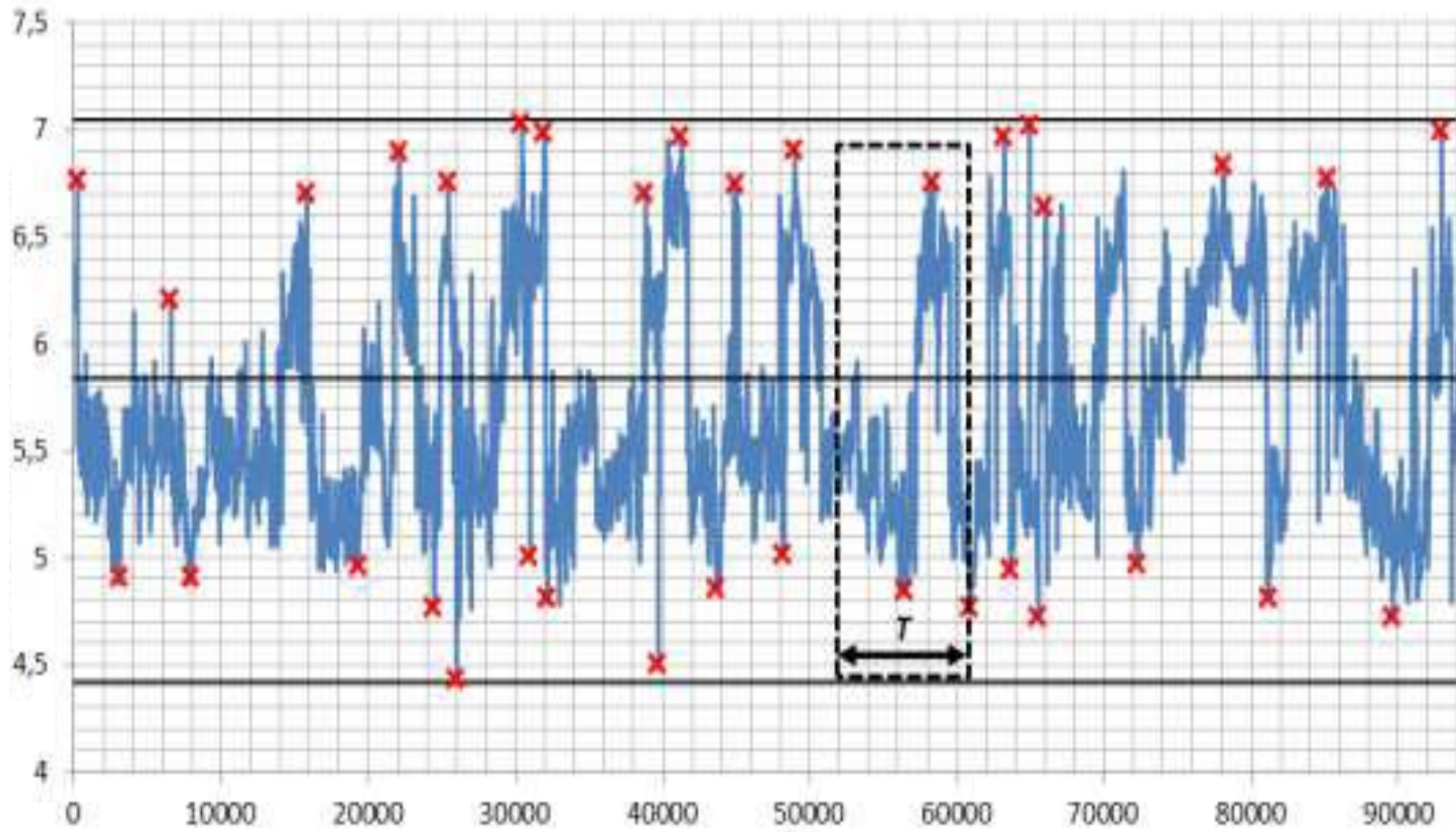
**General view of the fracture of a sample with an ILV crack, destroyed during fatigue tests**





Full spectrum of pressure fluctuations on the considered outlet loop of the compressor station for a period equal to 11 years of operation

Pressure at the section of the main gas pipeline, MPa

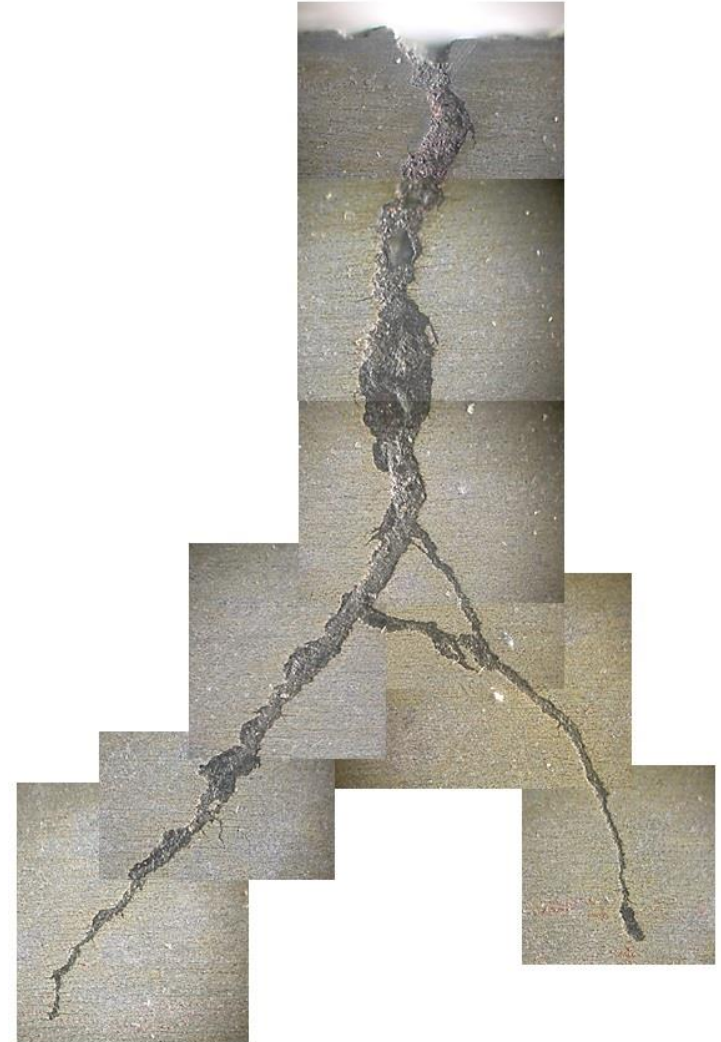


Pmax=7,0

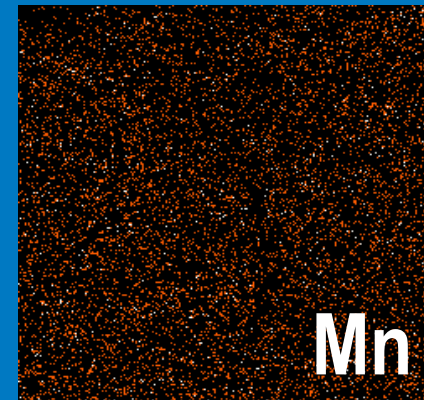
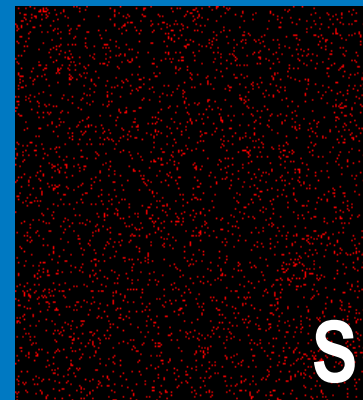
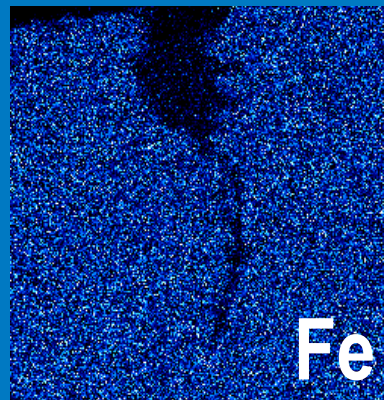
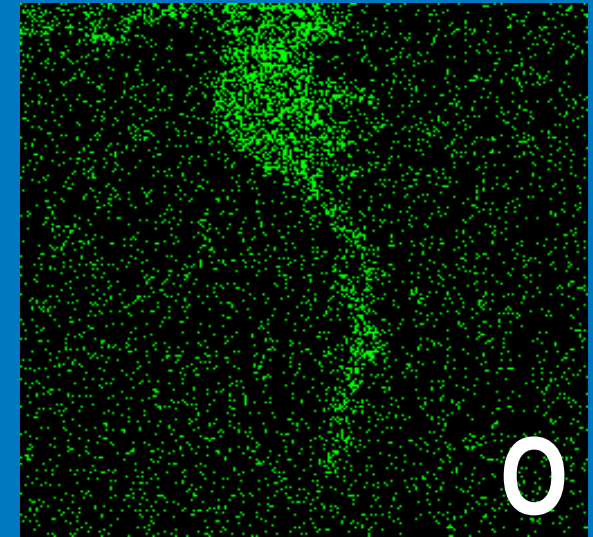
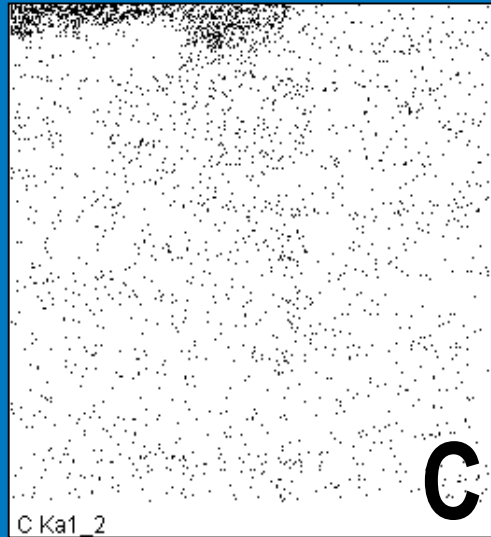
Pmin=7,0

Time, h

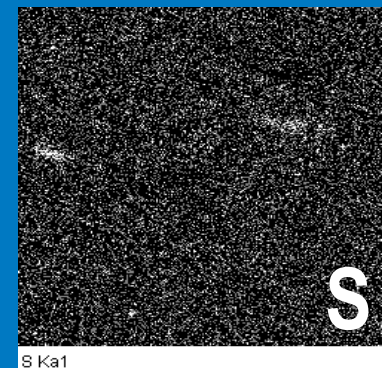
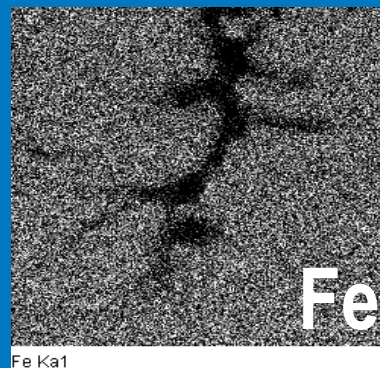
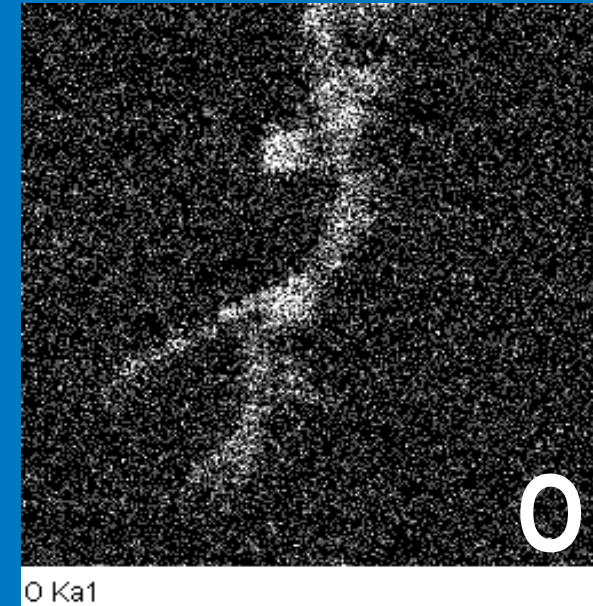
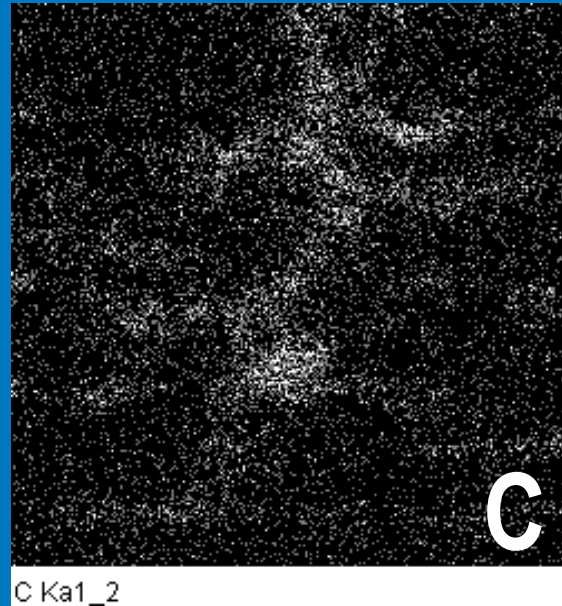
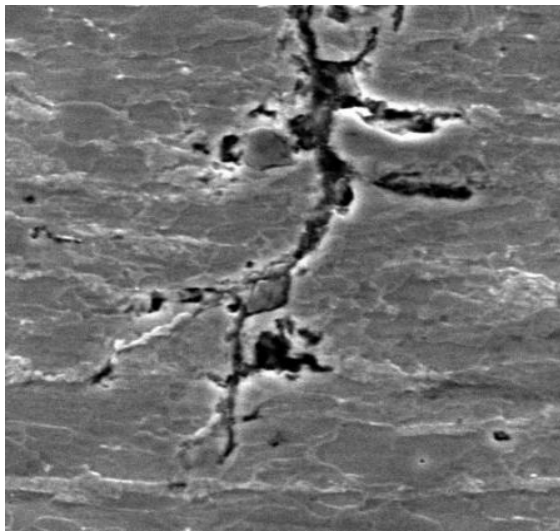
# The deepest SCC defects in the KR MG section of Gazprom Transgaz Samara, DN1400



**Electronic image of stress corrosion crack**



**Electronic image of stress corrosion crack**



# THANKS FOR ATTENTION

Komarov Dmitry Valerievich

Lead Engineer of Technical Condition and ETC (Engineering and Technical Center) Consistency Management

Gaz. phone.:(756) 63-278

E-mail: [D.Komarov@samaratransgaz.gazprom.ru](mailto:D.Komarov@samaratransgaz.gazprom.ru)

Antipov Sergey Vasilievich

Engineer of 1 category of Technical Condition and ETC (Engineering and Technical Center) Consistency Management

Gaz. phone.:(756) 63-284

E-mail: [S.Antipov@samaratransgaz.gazprom.ru](mailto:S.Antipov@samaratransgaz.gazprom.ru)