

FITNET

European Fitness-for-service Network

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Technical Report

Mapping of On-Going R&D Relevant to Fitness-for-Service Procedures

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1 Introduction

Work Package 2 has the following objectives:

- map on-going R&D work supporting FFS technology
- critical review of the technical status of existing FFS procedures
- review training possibilities and access to FFS technology
- determine priority areas for the development

The first step in this action has been to collect information on all on-going projects relevant to the overall scope of the network. A pre-formatted summary sheet was provided at the Kick-Off meeting in February and the network members were asked to submit these. The resulting information is collated in the present document under five headings. These correspond to the main technical working groups (fracture, fatigue, creep and corrosion) and a general section for projects with a broad scope.

2 Results for the Principal Technical Areas

2.1 Fracture

The following activity sheets have been submitted:

- 2.1.1 Structural integrity Assessment for Dynamic Loading and Crack Arrest
- 2.1.2 Fracture avoidance in laser welded thick structural steel plates with a yield strength between 235 and 890 MPa
- 2.1.3 Steel selection for fracture avoidance in steel ships
- 2.1.4 Numerical investigation of the fracture behaviour of laser welded structural steels with strength between 355 and 890 MPa and development of fitness for service rules.
- 2.1.5 Steel selection criteria for structural steels related to the fatigue strength catalogue of Eurocode 3
- 2.1.6 An energy balance approach to crack arrest
- 2.1.7 From processing to properties: Characterisation of toughness
- 2.1.8 Prediction of structural behaviour on the basis of small scale specimen testing
- 2.1.9 Role of Loading History in the Fracture Assessment of Structures
- 2.1.10 Structural integrity Assessment for Dynamic Loading and Crack Arrest
- 2.1.11 Fracture resistance of the steels for containers of spent nuclear fuel
- 2.1.12 Development of a Unified Procedure for Fracture Mechanics Tests
- 2.1.13 A Review Of Methods And Recommended Procedures To Evaluate The Static Strength Of Corroded Nozzles In Steel Pressure Vessels
- 2.1.14 Validation of Constraint Based Assessment Methodology in Structural Integrity
- 2.1.15 NESC-IV: An Investigation Of The Transferability Of Master Curve Technology To Shallow Flaws In Reactor Pressure Vessel Application
- 2.1.16 Assessment of Aged Piping Dissimilar Metal Weld Integrity
- 2.1.17 Structural Margin Improvements In Aged-Embrittled RPV With Load History Effects
- 2.1.18 Examination of the fracturing process with magnetic and electro-emission measuring technique

Title of Activity/Project:		
2.1.1 Structural integrity Assessment for Dynamic Loading and Crack Arrest		
Type of Activity		
Development of procedures to take into account Dynamic loading.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
24 Months	04/2000	03/2003
Summary		
Dynamic loading may affect both the loading and resistance sides of structural assessments for fracture and plastic collapse, but there are no clearly defined procedures as to when and how to take account of this type of loading. Finite element analyses will be carried out to establish magnification of stresses and stress intensity factors for a range of typical structural applications including wave slam, earthquake, impact and blast loading. FE analyses will also be used in a modified local approach to establish rated of crack tip loading, local strain rates and crack tip constraint associated with different types of loading. These will be compared with crack tip conditions for short cracks propagating into tough material. Tensile and fracture toughness tests will be carried out on selected high strength steels a different loading rates and temperatures. The results will be used to predict both dynamic fracture toughness and crack arrest toughness from tensile data. The likely effects of weldments will be explored with a view to further work in this area at a later stage.		
Deliverable(s) relevant to FITNET		
Guidance will be developed for practising engineers on the use of failure assessment diagram procedures for dynamic loading and short crack arrest cases		
Contact details		
Name	Dr C.S.Wiesner	Organisation TWI
Email		Country UK
Comments		

Title of Activity/Project:		
2.1.2 Fracture avoidance in laser welded thick structural steel plates with a yield strength between 235 and 890 MPa		
Type of Activity		
To derive a structural safety concept in combination with small scale fracture mechanics and fatigue tests.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 Months	07/1999	06/2002
Summary		
Many industries are interested in laser welding plate up to 25mm thick. Also safety relevant design characterisation of laser welds are needed due to crack deviation unavoidable welding defects and misalignment. Examination of the true fracture and deformation behaviour of laser welded plates of structural steels between 15 and 25mm in thickness. A structural safety concept will be derived in combination with small scale fracture mechanics and fatigue tests.		
Deliverable(s) relevant to FITNET		
Fracture toughness and fatigue data for laser welds.		
Contact details		
Name	Peter Harrison	Organisation Corus RD&T
Email	Peter.harrison@corusgroup.com	Country UK
Comments		

Title of Activity/Project:		
2.1.3 Steel selection for fracture avoidance in steel ships		
Type of Activity		
Development of modern fracture control methodology		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
42 Months	07/1996	12/1999
Summary		
The purpose of this project is to provide a modern fracture control methodology for welded steel ships, which will be applicable to both new vessel construction and the extension of service life of existing vessels. A five-part programme incorporating status surveys, fracture performance using small-scale tests, confirmation by large scale testing, procedure derivation, and final practical implementation will be followed. The aim is to provide a method that will ensure satisfactory levels of safety without penalising modern steels or the continued use of existing vessels.		
Deliverable(s) relevant to FITNET		
Derivation and implementation of a modern fracture control method		
Contact details		
Name Dr S. Kapoor	Organisation Corus RD&T	
Email	Country UK	
Comments		

Title of Activity/Project: 2.1.4 Numerical investigation of the fracture behaviour of laser welded structural steels with strength between 355 and 890 MPa and development of fitness for service rules. Sponsor: Deutsche Forschungs Gemeinschaft								
Type of Activity Numerical investigation of local stress strain distribution. J-Q-M approach. Derivation of crack driving force in terms of J-Integral. Verification with wide plate tests from ECSC FAST project and EU-4 th framework ASPOW project								
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)						
24 Months	07/00	06/02						
2.1.4.1 Summary It is well known from experiments that the fracture behaviour of laser welded plates is different to conventional weldments due to the narrow weld seam and the high strength overmatch especially for low strength steels. Hence, the conventional qualification methods for such welds and also the conventional fitness for purpose methods cannot be applied. Before this background the project aim is to quantify the local stress and strain behaviour of laser welded joints with potential cracks in the weld seam. Results shall be used to understand the local damage behaviour which leads to crack initiation, to understand why the crack emanates into the base metal in the upper shelf (crack-path deviation) and to modify existing fitness for purpose tools as they are provided by SINTAP or R6 or the recently developed JQM approach towards laser weldments. The calculation results will be compared to experimentally derived results from the FAST project.								
Deliverable(s) relevant to FITNET Results from project when the project is finished are available								
Contact details <table border="0" style="width: 100%;"> <tr> <td style="width: 33%;">Name Prof. W. Bleck</td> <td style="width: 33%;">Organisation RWTH Aachen,</td> <td style="width: 33%;">Department of Ferrous Metallurgy</td> </tr> <tr> <td>Email: Bleck@iehk.rwth-aachen.de</td> <td colspan="2">Country Germany</td> </tr> </table>			Name Prof. W. Bleck	Organisation RWTH Aachen,	Department of Ferrous Metallurgy	Email: Bleck@iehk.rwth-aachen.de	Country Germany	
Name Prof. W. Bleck	Organisation RWTH Aachen,	Department of Ferrous Metallurgy						
Email: Bleck@iehk.rwth-aachen.de	Country Germany							
Comments Note that this project will take account of results from the FAST project. Co-ordinator : Corus, S. Webster								

Title of Activity/Project: 2.1.5 Steel selection criteria for structural steels related to the fatigue strength catalogue of Eurocode 3 Sponsor: Deutsche Forschungs Gemeinschaft		
Type of Activity Performance of large scale tests with typical structural details used in static loaded building to verify the procedure for the selection of steels to avoid brittle fracture (known as Annex C, now prEN1993, part 1-10) in Eurocode 3 (prEN 1993-1, to be published in 2002).		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
12 Months	10/ 01	09 /02
Summary In an foregoing project typical structural details as they are used in fatigue loaded have been tested with a artificial fatigue crack of aprox. quarter thickness size to verify the fitness for service procedure used for the Eurocode 3 steels selection part to avoid brittle fracture. This procedure is based on fracture mechanics and utilises the master curve, the CEGB R6 FAD and the transition temperature correlation $T_{27J}-T_{100}$. In addition to this project which was finalised in 2000 a gap is closed for such details in non-fatigue loaded structures where joints between different profiles are used leaving a constructional gab of up to 50 % of the ligament of the tension member. The results will serve for the verification of the fitness for service procedure using semi-probabilistic methods.		
Deliverable(s) relevant to FITNET Test results will be available for verification use when project is finished.		
Contact details Name Prof. W. Bleck/ Dipl.-Ing. J. Buchholz Organisation RWTH Aachen, Department of Ferrous Metallurgy Email Bleck@iehk.rwth-aachen.de Joerg.buchholz@iehk.rwth-aachen.de Country Germany		
Comments Note that this project is performed together with Prof. Sedlacek from the Department of Steel construction at the RWTH Aachen		

Title of Activity/Project:		
2.1.6 An energy balance approach to crack arrest		
Type of Activity		
Development of a new approach to crack arrest		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
42 Months	07/1999	12/2002
Summary		
To confirm the viability of the energy balance approach for a range of steels and structural applications. Once confirmed a small scale test procedure will be defined together with initial guidelines on design and material property requirements		
Deliverable(s) relevant to FITNET		
• Appropriate small scale test procedure • Initial guidelines on design and material property requirements to ensure structural safety. •		
Contact details		
Name Simon Slater	Organisation Corus RD&T	
Email Simon.slater @corusgroup.com	Country UK	
Comments		

Title of Activity/Project:		
2.1.7 From processing to properties: Characterisation of toughness		
Type of Activity		
Development of model to predict Charpy toughness		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 Months	01/2001	12/2003
Summary		
To develop a generic model capable of predicting Charpy toughness by linking steel composition and thermo-mechanical process variables through the evaluation of microstructure. The model will provide the capability to predict Charpy toughness in all types requiring this test to pass the release specification.		
Deliverable(s) relevant to FITNET		
- Quantification of the dynamic loading / resonance contribution to the Charpy test. - A structure – property model of the Charpy test to predict toughness in all product types that use this test in the release specification.		
Contact details		
Name Adam Bannister	Organisation Corus RD&T	
Email Adam.bannister@corusgroup.com	Country UK	
Comments		

Title of Activity/Project:		
2.1.8 Prediction of structural behaviour on the basis of small scale specimen testing		
Type of Activity		
Development of small-scale test to replace current full scale fracture mechanics testing.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 Months	07/1998	06/2001
Summary (Of results)		
The local approach methodology was successfully used to predict the lower shelf fracture behaviour of real multipass welds using data derived from small-scale thermally simulated specimens. A coupled micro mechanical model designed to account for pre-cleavage ductile tearing was also used to predict transition region fracture behaviour of the grain coarsened heat affected zone (GHAZ). Unexpectedly, no upswing in toughness with temperature was observed in either the test results or the failure predictions. One possibility is that no conventional ductile to brittle transition of fracture toughness is present in this thermally simulated microstructure.		
Deliverable(s) relevant to FITNET		
Report describing effect of specimen component, weld preparation geometry and choice of modelling parameters on crack tip deformation behaviour, and how these calculations can be used for derivation of safety criteria.		
Contact details		
Name Dr W. Burget Organisation Fraunhofer-Institut für werkstoffmechanik Email bu@iwf.fhg.de Country Germany		
Comments		

Title of Activity/Project:		
2.1.9 Role of Loading History in the Fracture Assessment of Structures		
Type of Activity		
Quantification of the effects of loading history, and development of general guidelines for structural integrity assessments		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 Months	04/2000	03/2003
Summary		
Prior loading such as proof loading, post weld heat treatment, material ageing and subsequent loading history can have a significant influence on material behaviour. In many structures, prior loading will also have a strong influence on both the residual stresses and fracture toughness. However, it is not known whether these effects are exclusive or additive. For any material, fracture toughness and residual stress values will exhibit randomness so probabilistic analysis will be conducted using the model developed. Quantifying these effects of prior loading will provide improved confidence in determining the continued availability of the structure. Also the use of probabilistic provides quantities information about the likelihood of onset of failure taking into account uncertainties in input data. The joint project between Bristol University and TWI aims to provide a model to quantify the effects with some experimental verification. The project will also conduct case studies in order to develop general guidelines for structural integrity assessment.		
Deliverable(s) relevant to FITNET		
A model to help quantify the effect of loading history, and general guidelines for structural integrity assessment.		
Contact details		
Name	Dr C.S.Wiesner	Organisation TWI
Email		Country UK
Comments		

Title of Activity/Project:		
2.1.10 Structural integrity Assessment for Dynamic Loading and Crack Arrest.		
Type of Activity		
Development of procedures to take into account dynamic loading.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
24 Months	04/2000	03/2003
Summary		
Dynamic loading may affect both the loading and resistance sides of structural assessments for fracture and plastic collapse, but there are no clearly defined procedures as to when and how to take account of this type of loading. Finite element analyses will be carried out to establish magnification of stresses and stress intensity factors for a range of typical structural applications including wave slam, earthquake, impact and blast loading. FE analyses will also be used in a modified local approach to establish rated of crack tip loading, local strain rates and crack tip constraint associated with different types of loading. These will be compared with crack tip conditions for short cracks propagating into tough material. Tensile and fracture toughness tests will be carried out on selected high strength steels a different loading rates and temperatures. The results will be used to predict both dynamic fracture toughness and crack arrest toughness from tensile data. The likely effects of weldments will be explored with a view to further work in this area at a later stage.		
Deliverable(s) relevant to FITNET		
Guidance will be developed for practicing engineers on the use of failure assessment diagram procedures for dynamic loading and short crack arrest cases		
Contact details		
Name	Dr C.S.Wiesner	Organisation TWI
Email		Country UK
Comments		

Title of Activity/Project:			
2.1.11 Fracture resistance of the steels for containers of spent nuclear fuel			
Type of Activity		International research project	
Duration:		Start (mm/yyyy)	Finish (mm/yyyy)
		11/1998.	10/2001.
Summary: SKODA works developed a new steel type for the storing and transportation of spent nuclear fuel elements. Its introduction and wide application must be preceded by very detailed examinations, which also include the analysis of embrittlement susceptibility. The co-operating partners were: IPM Brno, Skoda Research, University of Metz, Bay Zoltán Institute Miskolc, University of Miskolc. The project was supported by NATO Science for Peace program. The objectives of the project were: – To provide the complex standard data set about container material fracture resistance. – To specify methods for fracture resistance assessment and embrittlement prediction. – To develop local approach, master curve methodology and fracture scaling model for purposes of data transferability assessment and brittle fracture prediction. – To develop procedures for dynamic problems modelling and for their use in brittle fracture characteristics prediction. – To obtain knowledge for using notched specimen in material toughness characterisation. As a result of the project a book has been issued by Kluwer			
Deliverable(s) relevant to FITNET			
• Local approach has been developed and applied for fracture toughness prediction. • Validity of Master curve methodology was proved for the steel both for the static fracture toughness and for the dynamic fracture toughness characteristics. • Two toughness scaling models have been applied and tested when transferring data from one specimen geometry to another one or when adjusting fracture toughness data in constraint dependent regime. • Theoretical and computational works on Dynamic tasks modelling have been finished and good correlation has been found between calculated characteristics and experimentally measured data. • Based on notch sensitivity analysis the method has been developed for fracture toughness determination arising from notched bend specimen having the Charpy type geometry.			
Contact details			
Name	Dr. Ivo Dlouhy	Organisation	Institute for Physics of Materials, Brno
Email	idlouhy@IPM.Cz	Country	Czech Republic
Comments			

Title of Activity/Project:			
2.1.12 Development of a Unified Procedure for Fracture Mechanics Tests			
Type of Activity		Development of fracture mechanics test methods within ESIS Subcommittee on fracture mechanics test standards	
Duration:	Start:	Finish:	
	April 2002	Mid 2004	
Summary The existing ESIS Procedure P2 was released in January 1992. It is a unified test method expressing the crack extension resistance in terms of J and CTOD for the plane strain case and for the whole temperature range from lower to upper shelf behaviour. The new activity is aimed at extending the existing methods to specimens with low constraint thus meeting the needs of thin-walled light-weight structures. The use of M(T) specimens is one of several new items.			
Deliverable(s) relevant to FITNET Fracture mechanics test method covering all temperatures below creep conditions and all constraint conditions.			
Contact details			
Name	Karl-Heinz Schwalbe	Organisation	GKSS
Email	schwalbe@gkss.de	Country	Germany
Comments			

Title of Activity/Project:		
2.1.13 Validation of Constraint Based Assessment Methodology in Structural Integrity		
Type of Activity		
DG-RTD FP5 Shared Cost Action (Vocalist)		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
48 Months	10/2000	10/2004
Summary		
The purpose of VOCALIST is to develop validated models of the constraint effect, and associated best practice advice, with the objective of achieving (i) an improved defect assessment methodology for predicting safety margins; (ii) improved lifetime management arguments. The work is intended to be of benefit to both plant operators and their regulators.		
Deliverable(s) relevant to FITNET		
Methodology and experimental benchmarks for applying constraint-based assessment procedures		
Contact details		
Name D. Lidbury	Organisation Serco Assurance	
Email	Country UK	
Comments		
Linked to the NESC-IV project		

Title of Activity/Project:		
2.1.14 NESC-IV: An Investigation Of The Transferability Of Master Curve Technology To Shallow Flaws In Reactor Pressure Vessel Applications		
Type of Activity		
NESC Network international project		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 Months	11/2000	12/2003
Summary		
NESC-IV is an experimental/analytical program to develop validated analysis methods for transferring fracture toughness data generated on standard test specimens to shallow flaws in reactor pressure vessel welds subject to biaxial loading in the lower-transition temperature region. It is the fourth major project of the Network for Evaluating Structural Components (NESC). The testing program has exploited material removed from a production-quality reactor pressure vessel. In Part A six clad cruciform specimens containing shallow surface-breaking flaws located in weld material were successfully tested. For Part B a further four beam tests were performed using an innovative test piece design with a simulated embedded flaw. Post-test analysis is now in progress.		
Deliverable(s) relevant to FITNET		
Final report at end of 2003 with implications for industrial practices in the treatment of shallow flaws in RPVs		
Contact details		
Name N. Taylor	Organisation JRC Petten	
Email	Country -	
Comments		

Title of Activity/Project:		
2.1.15 Assessment of Aged Piping Dissimilar Metal Weld Integrity		
Type of Activity		
DG-RTD FP5 Shared Cost Action “ADIMEW”		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 Months	11/2000	11/2003
Summary		
The ADIMEW project, will provide a unique large-scale verification of the performance of a defect-bearing dissimilar weld as found on primary circuit piping in many PWR plants. It aims to extend previous work on the simple bi-metallic to industrial scale dissimilar metal welds at normal operating conditions. A cracked dissimilar metal weld forming a 16” diameter piping assembly will be tested to determine the load for crack initiation and subsequent tearing to collapse. Two welds between low alloy A308/508 and austenitic 308/309 steel will be procured to a nuclear specification and high quality control, and will contain a weld buttering layer at the ferritic interface.		
Deliverable(s) relevant to FITNET		
Improved procedures for assessment of stability and safety of aged welds of this type: Several critical aspects are being examined, including the location of susceptible cracking sites, the role of residual stresses, material testing methods and analysis procedures. After evaluation of the results, recommendations will be formulated for improved codes and standards for use at European level.		
Contact details		
Name	C. Faidy	Organisation EDF
Email		Country France
Comments		
The NESC-3 project has been be formed around ADIMEW to provide - complimentary materials testing using surplus material - non-destructive testing to establish the detectability and sizing performance of industrial and advanced in-service inspection procedures, a key element in the integrated approach to structural integrity assessment - fracture analysis calculations to establish the validity of the ADIMEW recommended procedures and explore different aspects outside the scope of the present project. - peer-review of results and formulation of recommendations for improved codes and standards for use at European level. Under this arrangement NESC-3 participants will have access to the project documentation on a confidential basis.		

Title of Activity/Project:		
2.1.16 Structural Margin Improvements In Aged-Embrittled Rpv With Load History Effects		
Type of Activity		
DG-RTD FP5 Shared Cost Action "SMILE"		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
48 Months	1/2002	1/2006
Summary		
The aim of the SMILE project is to understand better the beneficial effect of the Warm Pre-Stressing (WPS) in the reactor pressure vessel structural integrity assessment, and to define and establish some recommendations for a pre-codification in European Codes and Standards. As part of the assurance of structural integrity, fracture mechanics analyses consider the behaviour of defects under normal and abnormal loading conditions to assess safety margins and components lifetimes as materials become degraded by embrittlement induced by irradiation and thermal ageing.		
Deliverable(s) relevant to FITNET		
• Proposal of guidelines for Codes and Standards : guidelines for pre-codification will be proposed to be introduced in various European and US Codes • Benchmark applications : using above guidelines, applications will be made on two cases representative of the transient to which real reactor pressure vessels are subjected		
Contact details		
Name	G. Bezdikian	Organisation EDF
Email		Country France
Comments		

Title of Activity/Project:			
2.1.17 Examination of the fracturing process with magnetic and electro-emission measuring technique			
Type of Activity	Hungarian project (OTKA)		
Duration:	Start	01/1999	Finish
			12/2002
Summary			
The main aim of the project is to carry out a more detailed analysis of the magnetic and electro-emission signals, and to find a clear connection between the processes taking place during fracture and the measured emission signals in the case of the most different materials. On the one part it means the analysis of the large number of measured data accumulated in the last few years from this aspect, using modern signal processing and digital filtering techniques. On the other part we intend to compare the different measuring methods potentially suitable for determining the instant of crack initiation (strain gauge technique, potential drop measurement). Apart from this, with systematic analysing work and with the help of further tests we intend to clarify what kind of material parameters influence the emission signals and how they do it. The project lasts for 4 years. It is realised in co-operation with the specialists of the University of Miskolc.			
Deliverable(s) relevant to FITNET			
The most important expected result of the project would be a more precise determination of the magnetic and electro-emission measuring techniques - which are considered as relatively new techniques even in international respect, and they are not yet widely used – and a more precise clarification of the connection of the measured signals with the material characteristics. These measurement procedures can be used in the determination of dynamic fracture mechanics characteristics of materials.			
Contact details			
Name	Dr. Gyöngyvér B. Lenkey	Organisation	Bay Zoltán Institute for Logistics and Production Systems
Email	lenkey@bzlogi.hu	Country	Hungary
Comments			

Title of Activity/Project:			
2.1.18 Development of toughness requirements for plastic design			
Type of Activity			
Duration:	Start	01/2002	Finish 12/2004
Summary			
The results of the Laboratory Soete (Ghent University, Belgium) Curved Wide Plate (CWP) test database and complementary small-test data will be correlated with the objective of assessing the weld metal CVN and/or CTOD toughness properties required to ensure failure by plastic collapse. The work is complementary to work being performed on the development of flaw acceptance criteria for pipe lines subjected to longitudinal plastic strains. The major results expected from this work are recommendations on the toughness requirements ensuring plastic collapse of thin wall structures. The recommendations will take the level of applied (plastic) strain and mismatch into account.			
Deliverable(s) relevant to FITNET			
Not defined			
Contact details			
Name	Wim De Waele/ Rudi Denys	Organisation	Ghent University
Email	Wim.DeWaele@rug.ac.be	Country	Belgium
Comments			

2.2 Fatigue

The following activity sheets have been submitted:

- 2.2.1 Fatigue behaviour of welded high strength steel components under combined multiaxial variable amplitude loading.
- 2.2.2 Fatigue design of stainless steel welds
- 2.2.3 Enhanced Life Prediction for Three Dimensional Fatigue Cracks
- 2.2.4 Enhanced fatigue performance of higher strength steel welded joints
- 2.2.5 HISTESHIP: Application of high grade-steel plates for welded deck components for ships and bridges submitted to medium/high service loads
- 2.2.6 Improved assessment of steel buildings performance during earthquakes
- 2.2.7 Therfat: Thermal Fatigue Evaluation of Piping System “T” Connections
- 2.2.8 Batelle support to ASME Div 2 Rewrite
- 2.2.9 FEA Procedures for Fatigue Design and Evaluation of Welded Structures

Title of Activity/Project:		
2.2.1 Fatigue behaviour of welded high strength steel components under combined multiaxial variable amplitude loading.		
Type of Activity		
Defining reliable design criteria for welded constructions.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
61 Months	12/1993	05/1997
Summary		
The aim of this project is to define reliable design criteria for welded constructions in the case of variable amplitude multiaxial loading, by collecting fatigue tests results providing realistic estimates of the fatigue life of such constructions, and by adapting the calculation methods of the existing codes. Fatigue tests on high strength Fe E 460 steel tubular connections submitted to bending and torsion will be performed.		
Deliverable(s) relevant to FITNET		
Definition of a reliable design criterion for welded constructions subjected to multiaxial loads..		
Contact details		
Name	Dr C. M. Sonsino	
Organisation	Fraunhofer-Institut für Betriebsfestigkeit , E.V.	
Email		
Country	Germany	
Comments		

Title of Activity/Project:		
2.2.2 Fatigue design of stainless steel welds		
Type of Activity		
Increasing the information available for fatigue performance in stainless steel welds		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
42 Months	07/1995	12/1998
Summary		
Although there is a wealth of information on the fatigue performance of welded carbon – manganese structural steels, welded stainless steels have been neglected. Consequently there is little data available upon which to provide guidance. Therefore a thorough study of the fatigue behaviour of welded austenitic and duplex steels, to investigate any differences between them and structural steels and to provide guidance.		
Deliverable(s) relevant to FITNET		
Fatigue endurance tests of typical welded joints Fatigue crack growth rate and threshold tests Metallurgical and fractographic examinations to establish the influence of microstructure Residual stress measurements Fatigue life modelling using local strain and fracture mechanics concepts.		
Contact details		
Name Dr C. M. Sonsino	Organisation Fraunhofer-institut für betriebsfestigkeit (LBF), E.V.	
Email	Country Germany	
Comments		

Title of Activity/Project:		
2.2.3 Enhanced Life Prediction for Three Dimensional Fatigue Cracks		
Type of Activity		
Building the foundations for the next generation of fatigue crack prediction methodologies.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
41 Months	10/2000	03/2004
Summary		
Detailed measurements of plastically induced fatigue crack closure and crack growth rates will be undertaken for three dimensional geometries under non-uniform loading. Finite element modelling will be used to produce a detailed model of crack behaviour, including crack tip plasticity and closure. The predictions of this model will be compared with the experimental observations and with the results from a simplified two dimensional plane stress and plane strain 'strip yield' models and with a 'plane yield' model formulated using the eigenstrain method. The proposed work is to be performed in collaboration with the University of Bristol, Rolls Royce plc and British Aerospace (Airbus) EngProg.		
Deliverable(s) relevant to FITNET		
Development of the next generation of methodologies for the prediction of fatigue crack growth rates		
Contact details		
Name Dr D. Nowell	Organisation University of Oxford	
Email	Country UK	
Comments		

Title of Activity/Project:		
2.2.4 Enhanced fatigue performance of higher strength steel welded joints		
Type of Activity		
Development of fatigue properties of welded joints		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
12 Months	01/2001	12/2001
Summary		
To investigate the potential for improving fatigue life of welded structures through the use of higher strength steels with matching strength welds.		
Deliverable(s) relevant to FITNET		
Confirmation of the potential for higher strength steels and matching welds to provide enhanced fatigue performance.		
Contact details		
Name Chris Lindley	Organisation Corus RD&T	
Email Chris.lindley@corusgroup.com	Country UK	
Comments		

Title of Activity/Project:		
2.2.5 HISTESHIP: Application of high grade-steel plates for welded deck components for ships and bridges submitted to medium/high service loads		
Type of Activity		
Development of knowledge of high grade steel plates.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 Months	07/2001	06/2004
Summary		
- To develop and improve the engineering knowledge necessary for optimising the design and manufacturing the components subjected to heavy service life loads, in terms of fatigue under both quasi-static and dynamic (crash) loads. - To gain good advantage in the use of high grade plates steels for welded structures subjected to fatigue and high rate loading. - To study the design, construction and testing of both bulb-flattened panels and sandwich panels for use as cargo ship decks.		
Deliverable(s) relevant to FITNET		
- Fabrication and welding procedures required for the construction of high strength stiffened and sandwich panels. - Understanding of the fatigue properties and behaviour of high strength steel panels with novel T-bulb stiffeners and corresponding sandwich panels		
Contact details		
Name John Horsley	Organisation Corus RD&T	
Email John.Horsley@corusgroup.com	Country UK	
Comments		

Title of Activity/Project: 2.2.6 Improved assessment of steel buildings performance during earthquakes						
Type of Activity: Development of the analysis of steel structures under earthquake conditions						
Duration 24 months	Start(mm/yyyy) 05/1996	Finish(mm/yyyy) 04/1998				
Summary: The project concerns the analysis of the behaviour of civil engineering steel structures, of the moment resisting category, under earthquake loads. The objective is it implement In such an analysis a quantitative reference to the failure connections in terms of low cycle fatigue considering the duration of the earthquakes and the corresponding number of cycles supported in dissipative (plastic) zones.						
Deliverable(s) relevant to FITNET Improved assessment and analysis of steel structures in earthquake zones.						
Contact details <table> <tr> <td>Name Paolo Pezzoli</td> <td>Organisation Ismes SpA</td> </tr> <tr> <td>Email</td> <td>Country Italy</td> </tr> </table>			Name Paolo Pezzoli	Organisation Ismes SpA	Email	Country Italy
Name Paolo Pezzoli	Organisation Ismes SpA					
Email	Country Italy					
Comments 						

Title of Activity/Project:		
2.2.7 Therfat: Thermal Fatigue Evaluation of Piping System “T” Connections		
Type of Activity DG-RTD FP5 Shared Cost Action		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
48 Months	12/2001	11/2005
Summary Thermal fatigue is a recurring problem when LWR plants become older and life time extension activities are initiated. THERFAT proposes to review field data and perform advanced thermohydraulic flow simulations and stress and fracture analysis. Critical elements of the procedure will be investigated by targeted verification tests. Proposals will be made for improved load thermal fatigue assessment procedures, screening criteria and for establishing a European Methodology on Thermal Fatigue.		
Deliverable(s) relevant to FITNET THERFAT is expected to generate the following main results and deliverables. • Assessment of field data on thermal fatigue of Tees. • Capabilities of thermo-hydraulic analysis to capture turbulent thermal loads, verified by experiments. • Development of virtual sensor for load monitoring. • Advanced analysis of TF damage and impact on operational screening criteria. • Verification of TF damage quantification using existing and new test data. • Final Report on evaluation procedures for initiation and propagation of thermal fatigue in Tees and strategy for a "European Methodology on Thermal Fatigue".		
Contact details		
Name K.J. Metzner	Organisation E.ON Kernkraft	
Email	Country Germany	
Comments		

Title of Activity/Project:			
2.2.8 Batelle support to ASME Div 2 Rewrite			
Type of Activity	Provide technical background write up and data analysis		
Duration:	Start (mm/yyyy)	01/00	Finish (mm/yyyy) 01/04
Summary Battelle support to the following activities: (1) Fatigue evaluation procedures using structural stress based master S-N curve for welded components; (2) Residual stress estimate for FFS assessment; (3) unified time-temperature-thickness requirements for PWHT (1) Analyse existing vessel and pipe weld s-n data; propose master S-N curve; document FEA procedures (2) Treatment of weld residual stresses in stress intensity factor solutions (3) Analyse stress relaxation process during PWHT and develop unified hold time, PWHT temperature and thickness requirements for performing PWHT for residual stress relief purposes.			
Deliverable(s) relevant to FITNET Recommendations and guidelines on: (1) Fatigue evaluation procedures and master s-n curve with code-specified confidence levels (2) Stress intensity factor solutions procedures for considerations of various residual stress profiles (3) Specifications on heating up rates, hold time duration, thickness effects for typical pressure vessel steels in PWHT			
Contact details			
Name	Pingsha Dong	Organisation	Battelle
Email	dongp@battelle.org	Country	U.S.A
Comments			

Title of Activity/Project:			
2.2.9 FEA Procedures for Fatigue Design and Evaluation of Welded Structures			
Type of Activity	Joint industry project with 10 international automotive, offshore/nuclear companies		
Duration:	Start (mm/yyyy)	Dec, 00	Finish (mm/yyyy) July, 03
Summary			
1. Develop and refine Battelle's mesh-insensitive structural stress procedures for applications in welded joints 2. Establish a comprehensive S-N database 3. Develop master S-N curve approach 4. Automate the structural stress calculation procedures for practical applications in complex structures 5. Refine existing hot spot stress procedures for offshore/marine applications			
Deliverable(s) relevant to FITNET			
1. Detailed technical background and automated FEA post-processing procedures 2. Recommendations for adoptions for applications in offshore/marine and ASME communities.			
Contact details			
Name	Pingsha Dong	Organisation	Battelle
Email	dongp@battelle.org	Country	U.S.A.
Comments			

2.3 Creep

The following activity sheets have been submitted:

- 2.3.1 British Energy R5 Procedures
- 2.3.2 Integrity Assessment During Operation: EPERC TTF5
- 2.3.3 'Integrity' – Integrity of repair welds in high temperature plant operating under steady and cyclic load conditions
- 2.3.4 Small punch testing method.
- 2.3.5 ESIS TC11 - Working Group: High Temperature Testing of Weldments
- 2.3.6 IIW – International Institute of Welding: Commissions IX and X
- 2.3.7 VAMAS – TWA 25: Creep/ Fatigue Crack Growth in Components
- 2.3.8 Development of a non-continuum model to predict reheat crack growth
- 2.3.9 ECCC (European Creep Collaborative Committee)
- 2.3.10 CRETE
- 2.3.11 Arbeitsgemeinschaft für warmfeste Stähle Working Group W14 "Kriechriss-wachstum"
- 2.3.12 Arbeitsgemeinschaft für warmfeste Stähle: Working Group W10 Hochtemperatur-verhalten unter veränderlicher Beanspruchung"
- 2.3.13 Validation, expansion and standardisation of procedures for high temperature defect assessment
- 2.3.14 Probabilistic and Sensitivity of Crack Assessment in High Temperature Plant and Applicability of HIDA Procedure

Title of Activity/Project:		
2.3.1 British Energy R5 Procedures		
Type of Activity		
Development of the R5 defect assessment procedures		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
	04/2002	continues
Summary		
The R5 Procedures are the subject of a continuing development programme involving British Energy and Serco Assurance (formerly AEA Technology). There is an ongoing research activity to develop R5. In 2002/03, the main areas of development are: • Improved methods for assessing incubation; • Use of FAD (ECCC) and σ_d approaches; • Crack growth in CMV weldments; • Crack growth in dissimilar metal welds; • Constraint effects. • Alternative test specimens (CRETE).		
Deliverable(s) relevant to FITNET		
• Updated advice on assessing incubation. • Updated advice on crack growth in CMV weldment zones. • Report on methods for assessing crack growth in dissimilar weldments. • CRETE Report. • Report on constraint effects on crack growth..		
Contact details		
Name: Bob Ainsworth Organisation British Energy Generation Ltd Email: bob.ainsworth@british-energy.com Country UK		
Comments		

Title of Activity/Project:		
2.3.2 Integrity Assessment During Operation: EPERC Technical Task Force 5		
Type of Activity		
EPERC Technical Task Force		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
	04/1999	continues
Summary		
EPERC TTF5 covers the pressure equipment (in particular defined in the Pressure Equipment Directive) and concentrates on plant operation aspects including component integrity, residual life assessment, repair and effect of material damage in the component integrity and residual life • Includes representatives from the plant operators, the end-users of PE, safety authorities, service providers and PE manufacturers. • Covers several disciplines including creep, fatigue, fracture, material damage and ageing, inspection, monitoring and measurements at all temperatures.		
Deliverable(s) relevant to FITNET		
Flow of information from projects running under and fostered by TTF5 touching upon creep and creep-fatigue damage, repair and residual life assessment → Efficient and beneficial interaction		
Contact details		
Name: Dr. V. Bicego / Dr. C. Filiou Organisation CESI/ JRC-IE Email: bicego@cesi.it / filiou@jrc.nl Country ITALY/ NL		
Comments		

Title of Activity/Project: 2.3.3 Integrity of repair welds in high temperature plant operating under steady and cyclic load conditions		
Type of Activity EC FUNDED PROJECT: GRD1-10886– FP 5 UNDER “GROWTH”		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 months	01/2000	12/2003
Summary Life assessment and reliability performance of repair welds: • Prediction of creep & creep-fatigue crack initiation and growth in repair welded components • Creep & creep-fatigue crack initiation and growth – FE modelling relating this behaviour along interfaces with gradient of properties to microstructure and properties of the repair weld region → Lifetime assessment • Correlation with findings of the uniaxial creep damage & continuous damage mechanisms and with creep crack growth • Correlation of damage development to NDT findings and inspection of repair welds • Quantification of the effect of residual stresses – especially for cold welds, on the life of repaired components • Study to address both full and partial repair welds; novel welding techniques and repair welds with no PWHT		
Deliverable(s) relevant to FITNET • Better understanding of mechanisms of creep and creep-fatigue crack initiation and growth in repair welded components • Proposal for a life and risk assessment procedure for repaired components		
Contact details Name: Dr. Andreas Klenk Organisation MPA, University of Stuttgart Email: andreas.klenk@mpa.uni-stuttgart Country GERMANY		
2.3.3.1 Comments 		

Title of Activity/Project:		
2.3.4 Small punch testing method.		
Type of Activity		
Round Robin Exercise – Contribution in Kind project falling under EPERC TTF5		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
	04/2000	continues
Summary		
• Small punch test: Direct measurement of materials mechanical properties using a minimally invasive technique sampling from service components – Comparison of existing practices, in terms of methodology & reproducibility – concentrates on creep • SP creep rupture data assessment, comparison and data variability analysis • Results modelling- equivalent stress concept • Comparison of existing variants of test systems currently available for creep measurements • Definition of test conditions & procedures to give robust and repeatable results		
Deliverable(s) relevant to FITNET		
Test procedure for a minimally invasive method for direct measurement of creep properties → Residual life analyses of plant components		
2.3.4.1 Contact details		
Name: Dr. V. Bicego	Organisation CESI	
Email: bicego@cesi.it	Country ITALY	
2.3.4.2 Comments		

Title of Activity/Project:		
2.3.5 ESIS TC11 - Working Group: High Temperature Testing of Weldments		
Type of Activity		
Review of testing procedures and assessment of test data to produce a CoP for High Temperature Testing of Weldments.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
48 months	11/2001	11/2005
Summary		
The WG addresses the issues of testing and analysis of high temperature crack initiation and growth data for assessment of weldments – similar and dissimilar. A code of practice (CoP) will be issued within 4 years at the latest		
Deliverable(s) relevant to FITNET		
Up-to-date advice on testing and assessment of weldments for - crack initiation, - crack growth, - correlation of data, - correlation parameters		
Contact details		
Name: Bilal Dogan		Organisation: GKSS
Email: Bilal.dogan@gkss.de		Country: GERMANY
Comments		

Title of Activity/Project:		
2.3.6 IIW – International Institute of Welding: Commissions IX, X and XI		
Type of Activity		
Testing and analysis of welds, Codes and regulations for remnant life assessment.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
	08/2001	
Summary		
1- Commission IX, WG: High Temperature Behaviour of Welded Joints The WG 1 addresses the issues of testing and analysis of high temperature welds, 2- Commission X, WG: High Temp. Testing and Analysis of Welds. The WG 2 addresses the issues of Design of welded components, Creep behaviour of steels and welds, Design and assessment of components, Monitoring and Inspection, for remanent life assessment for creep loaded components and installations 3 - Commission XI : Pressure vessels, boilers and pipelines		
Deliverable(s) relevant to FITNET		
State- of- the- art reviews on the issues stated in the summary above.		
Contact details		
Name: Bilal Dogan	Organisation GKSS	
Email: Bilal.dogan@gkss.de	Country GERMANY	
Comments		

Title of Activity/Project:		
2.3.7 VAMAS – TWA 25: Creep/ Fatigue Crack Growth in Components		
Type of Activity		
Review of available procedures and assessment of RR results to produce Recommendations in procedures for component creep/fatigue crack growth testing and analysis.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
72 months	03/1998	03/2004
Summary		
TWA 25 aims at establishing accurate and reliable procedures for assessing creep/fatigue crack growth at elevated temperatures in components with defects.		
Deliverable(s) relevant to FITNET		
Reports on procedures for analysing the creep/ fatigue crack growth test data using fracture mechanics concepts, and predicting component behaviour in creep/ fatigue loading.		
Contact details		
Name: Bilal Dogan	Organisation GKSS	
Email: Bilal.dogan@gkss.de	Country GERMANY	
Comments		

Title of Activity/Project:		
2.3.8 Development of a non-continuum model to predict reheat crack growth		
Type of Activity		
IMC sponsored project on R&D of non-continuum models of inter-granular cracking in SAZ of type 316H stainless steel		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
12 months	11/2001	11/2002
Summary		
Various mechanistic models are reviewed of the nucleation and growth of cavities in grain boundaries, as well as the creep crack growth caused by this damage mechanism. These models take into account: - Cavitation growth by grain boundary diffusion - Cavitation growth by dislocation creep A damage model involving constraint cavitation is being developed and programmed, with the purpose of developing a tool to prediction the creep crack growth by grain boundary cavitation. It takes into account metallurgical parameters, evolving during service and whose initial values depending on pre-straining conditions caused by welding.		
Deliverable(s) relevant to FITNET		
Provide a better understanding of reheat crack problems by means of - Advising on the most suitable models to use for predictions of reheat cracking - Delivering of tools for prediction of reheat crack growth for typical test specimens. - Identification of causes of reheat cracking.		
Contact details		
Name: Annette D. Karstensen		Organisation: TWI
Email: annette.karstensen@twi.co.uk		Country UK
Comments		
This work is sponsored by IMC		

Title of Activity/Project:			
2.3.9 ECCC (European Creep Collaborative Committee)			
Type of Activity			
Industry led interest group, funded to date by a series of EC network initiatives (currently Advanced Creep Thematic Network)			
Duration:	Start	1992	Finish (mm/yyyy) continuing
Summary			
ECCC was originally formed to enable industry to influence/provide creep-rupture strength values for European product and design standards. ECCC working guidelines covering creep terminology, data generation and data assessment are also offered to appropriate standards committees and available for use by other users. The scope of activities has subsequently expanded to cover the testing/assessment of welds and post service exposed material, and more recently (funded by the Advanced Creep Thematic Network): creep strain, creep ductility, stress relaxation, multi-axiality, creep crack initiation and components.			
Deliverable(s) relevant to FITNET			
- Published volumes covering ECCC guidelines/recommendations concerning terminology, data acceptability criteria, testing practices, data collation/exchange, data assessment procedures - ECCC data sheets			
Contact details			
Name	Stuart Holdsworth	Organisation	ALSTOM Power
Email	stuart.holdsworth@power.alstom.com	Country	UK
Comments			

Title of Activity/Project:			
2.3.10 CRETE			
Type of Activity			
Development and harmonisation of creep crack growth testing for industrial specimens: a route to a European Code of Practice			
Duration:	Start	Sept. 2001	Finish
			Aug. 2004
Summary			
Development of testing methods for industrial system relevant specimens, harmonisation of creep crack growth analysis and assessment of data for component fitness assessment.			
Deliverable(s) relevant to FITNET			
- CoP for testing and analysis of metallic materials under creep conditions - Material selection criteria for testing and assessment			
Contact details			
Name	Bilal Dogan	Organisation	GKSS
Email	Bilal.Dogan@gkss.de	Country	D
Comments			

Title of Activity/Project:			
2.3.11 Arbeitsgemeinschaft für warmfeste Stähle Working Group W14 “Kriechrischwachstum”			
Type of Activity	German industry lead working group on the research field Creep Crack Initiation and Creep Fatigue Crack Initiation		
Duration:	Start	1984	Finish
			continuing
Summary			
The German Two-Criteria-Method ("2CM") " for pure creep crack initiation at heat resistant power plant steels is used for direct specimens data transfer to components with the same crack tip- and farfield-situation. The applicability of a Two-Criteria-Diagram ("2CD") is proven by more than 100 specimens with natural and artificial defects. A modified "2CM" is proposed for creep fatigue crack initiation with hold times.			
Deliverable(s) relevant to FITNET			
• assessment procedure • testing practices			
Contact details			
Name	Dr. J. Ewald Dr. A. Klenk Dr. A. Scholz	Organisation	Mülheim MPA-Stuttgart IfW TU Darmstadt
Email	scholz@ifw.tu-darmstadt.de	Country	Germany
Comments			

Title of Activity/Project:											
2.3.12 Arbeitsgemeinschaft für warmfeste Stähle: Working Group W10 “Hochtemperaturverhalten unter veränderlicher Beanspruchung”											
Type of Activity	Industry lead working group on the research field “Creep-Fatigue”										
Duration:	Start	1975	Finish continuing								
Summary Life of high temperature components of steam power plants depends on variable service conditions such as start-up phases and shut-down phases as well as load phases representing constant loading conditions. The multi-stage creep fatigue behaviour was investigated by service-type experiments and numerical simulation. Therefrom knowledge on cyclic deformation and creep fatigue damage assessment has been obtained. The industrial benefit can be summarized as follows: • Generation of long term service type creep fatigue design data up to 70 000 h. • Deformation can be predicted by user programme SARA on the basis of rules about deformation, relaxation and cyclic stress strain behaviour including internal stress and mean stress. • A creep fatigue life assessment procedure has been developed for multi-stage loading at power plant components. • Multi-stage creep fatigue life can be predicted by SARA. Keywords: service-type strain cycling, multi-stage loading, life analysis, internal and mean stress, cycle counting, heat resistant steels											
Deliverable(s) relevant to FITNET • description of IfW creep fatigue life prediction method, • case study, testing practices											
Contact details <table border="0"> <tr> <td>Name</td> <td>Dr. A. Scholz, Dr. T.-U. Kern (Head of Working Group W10)</td> <td>Organisation</td> <td>IfW TU Darmstadt , Siemens PG Mülheim</td> </tr> <tr> <td>Email</td> <td>scholz@ifw.tu-darmstadt.de</td> <td>Country</td> <td>Germany</td> </tr> </table>				Name	Dr. A. Scholz, Dr. T.-U. Kern (Head of Working Group W10)	Organisation	IfW TU Darmstadt , Siemens PG Mülheim	Email	scholz@ifw.tu-darmstadt.de	Country	Germany
Name	Dr. A. Scholz, Dr. T.-U. Kern (Head of Working Group W10)	Organisation	IfW TU Darmstadt , Siemens PG Mülheim								
Email	scholz@ifw.tu-darmstadt.de	Country	Germany								
Comments											

Title of Activity/Project:			
2.3.13 Validation, expansion and standardisation of procedures for high temperature defect assessment			
Type of Activity		DG-RTD FP4 project HIDA	
Duration:	Start	Finish	31-12-1999
Summary			
Accurate component life prediction is crucial to the safe, reliable and economic performance of all types of high temperature plant. It is particularly difficult when components are found to contain crack-like surface or embedded defects, since for these situations there are no well-established International or European Standards. Some guidelines or methodologies do exist within Germany, France and the UK but difficulties with them are the lack of commonality and very limited validation thus significantly limiting their application. - validating and expanding the database of the existing high temperature defect assessment procedures by conducting tests on component type geometries and 'scoping' tests on standard laboratory type specimens, together with data from plant experience - developing new methodologies for predicting the behaviour of high temperature components operating under steady and/or cyclic load conditions with a view to refining the present procedures - unifying and refining existing procedures with a view to making recommendations for a Euro-Standard - developing a knowledge-Based System for HIDA demonstration and applicability, and - providing a Database for materials used in high temperature applications for fossil and nuclear power plant and for process and petrochemical plant. The materials include the pressure vessel piping materials 2.25Cr1Mo (550°C), AISI 316 Stainless Steel (550°), and ASTM Grade 91 (600°), a 1CrMoV forged rotor material (530°) and a cast 1CrMoV casing material (530°C).			
Deliverable(s) relevant to FITNET			
Procedures and data for creep crack growth assessments			
Contact details			
Name	SHIBLI, Ahmed (Dr)	Organisation	European Technology Development Ltd
Email		Country	UK
Comments			

Title of Activity/Project:			
2.3.14 Probabilistic and Sensitivity of Crack Assessment in High Temperature Plant and Applicability of HIDA Procedure			
Type of Activity	DG-RTD FP5 project		
Duration:	Start	01-04-2002	Finish 31-03-2005
Summary			
This proposal aims to incorporate appropriate probabilistic assessment methodologies in to the European high temperature crack assessment procedure 'HIDA'. The work involves carrying out sensitivity analysis and probabilistic assessment of the large data base of the HIDA Databank (which forms a part of the HIDA Knowledge Base System (KBS)) and re-organising the data in a suitable format. This will be done so that the HIDA Procedure and the HIDA-KBS can be used by high temperature industry (such as petrochemical, nuclear, power plant or waste incineration) for life and safety assessment of components containing design allowable or service induced crack like defects.			
Deliverable(s) relevant to FITNET			
Procedures and data for creep crack growth assessments			
Contact details			
Name	SHIBLI, Ahmed (Dr)	Organisation	European Technology Development Ltd
Email		Country	UK
Comments			

2.4 Corrosion

The following activity sheets were received.

- 2.4.1 The application of FAD in the assessment of environmental assisted cracking and fracture conditions
- 2.4.2 Shell Handbooks for Corrode Pressure Equipment
- 2.4.3 SCC Behaviour Of Pipeline Microalloyed Steels
- 2.4.3 Assessment of metal loss defects in pipelines using finite element analyses
- 2.4.4 Application of new fracture mechanics concept to hydrogen damage evaluation
- 2.4.5 A Review Of Methods And Recommended Procedures To Evaluate The Static Strength Of Corroded Nozzles In Steel Pressure Vessels

Title of Activity/Project:		
2.4.1 The application of FAD in the assessment of environmental assisted cracking and fracture conditions		
Type of Activity		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
Summary		
The environmental working conditions of structural steels, as in the cases of energy and oil installations, established the need to find appropriated methodologies for characterising their cracking resistance. The characterization of very tough steels actually used has been resolved after a methodology that determines the kinetics of cracking as a function of the parameters which control this process, both in elastic and elasto-plastic domains. These parameters enable the crack propagation process to be modelled on a microstructural scale, to be subcritical, either intergranular or transgranular, or critical once final fracture appears. The application to such modelling to the structural scale is the objective of this paper. Therefore a FAD (Failure Assessment Diagram) type analysis has been done to define the hydrogen assisted cracking processes in samples of two different microalloyed steels.		
Deliverable(s) relevant to FITNET		
Contact details		
Name: J.A. Alvarez Laso & F. Gutiérrez-Solana		Organisation: Universidad de Cantabria
Email:.	Country	Spain
2.4.1.1 Comments		

Comments

Title of Activity/Project:			
2.4.3 Assessment of metal loss defects in pipelines using finite element analyses			
Type of Activity		Industrial R&D contract	
Duration:		Start (mm/yyyy)	Finish (mm/yyyy)
		05/2000	04/2001
Summary			
A practical problem occurring at MOL Plc. company in the course of the operation of gas and oil pipelines is the assessment of the pipelines' condition with corrosion-type metal loss defects and the estimation of their remaining life time. The basic aim of the project was to elaborate a model building method of the corrosion defect occurring on the pipelines and to carry out its finite element modelling. Within the project the measuring and modelling methods of the corrosion defect have been elaborated. Using laser-measurement technique a precise and some simplified defect models have been made about the defect. Using the different defect models, with the finite element method we examined the stress state of the pipeline during operation, as well as the failure pressure and the effect of the complexity of the defect model on the obtained results. On the basis of the calculations performed we tried to answer the following questions: for what type of metal loss defects is it recommended to apply finite element modelling instead of the analytic calculation; what effect does the complexity of the simplified models have on the reliability of the obtained results; how much time is needed for making a model (measurement and model building) of satisfactory accuracy, and what are its limits? The modelling results were compared with experiments and good agreement was found. The applicability of some simplified defect models was proved.			
Deliverable(s) relevant to FITNET			
Measurement technique for 3D defect geometry. Modelling method and failure criteria for estimation of the failure pressure of pipes using simplified defect geometry.			
Contact details			
Name	Dr. Gyöngyvér B. Lenkey	Organisation	Bay Zoltán Institute for Logistics and Production Systems
Email	lenkey@bzlogi.hu	Country	Hungary
Comments			

Title of Activity/Project:		
2.4.4 Application of new fracture mechanics concept to hydrogen damage evaluation		
Type of Activity		
Development of new criterion for hydrogen damage evolution.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 Months	07/1998	06/2001
Summary		
The development of high strength steels for certain industrial applications is tempered by the requirement for adequate resistance to hydrogen assisted cracking. Conventional embrittlement testing or stress corrosion cracking tests in various environments, provides limited information on hydrogen damage evaluation or fitness for service, whereas further alloy development require information of a more quantitative nature. This project aims to apply the local approach to fracture to describe failure in the heterogeneous zones to the problem of hydrogen damage evolution. The object is to develop a suitable failure criterion accounting for the local stress and strain distribution, local hydrogen concentration and local microstructure with the express aim of applying such a criterion to the conventional methods for testing the resistance to hydrogen assisted cracking and to the service conditions.		
Deliverable(s) relevant to FITNET		
Improved failure criterion in hydrogen damage evolution, for both conventional test methods and known service conditions.		
Contact details		
Name Mr L. Lesne	Organisation Irsid, Groupe Usinor	
Email	Country France	
Comments		

Title of Activity/Project:				
2.4.5 A Review Of Methods And Recommended Procedures To Evaluate The Static Strength Of Corroded Nozzles In Steel Pressure Vessels				
Type of Activity	Procedure development project			
Duration:	Start	1997	Finish	1999
Summary: Alternative procedures for the structural assessment of the integrity of corroded nozzles are examined. As the effect of non-uniform corrosion on the local stress distribution at a nozzle is complex and no standard method of corrosion assessment has been generally accepted, a procedure was developed to evaluate existing corrosion damage based on the existing standards and codes for the design and assessment of nozzles. he following conclusions have been drawn: - Global collapse of corroded nozzles can be avoided by assessing the nozzle using any of the following methods: the ASME VIII Division 1 area replacement rules; the Rodabaugh equivalent burst pressure method or the BS 5500 elastic stress design rules. The use of these methods to assess corrosion can be based on the minimum wall thickness. - Comparison of the minimum wall thickness obtained using the area replacement, Rodabaugh or elastic stress methods of nozzle design, showed that in many cases the BS 5500 elastic stress method gave a lower predicted minimum wall thickness than the others. However, no method gave consistently lower allowable minimum wall thicknesses compared to the other . - Use of a global collapse assessment criteria is in itself inadequate to ensure fitness-for-purpose. Local collapse of the corroded ligament must also be considered. - Compliance with the design methods described in ASME VIII, BS 5500 or Rodabaugh, may be insufficient to ensure the integrity of the corroded nozzle. Consideration should also be given to alternative failure mechanisms such as buckling, brittle failure and fatigue. It is also recommended that as well as assessing the affected region, the reasons for corrosion or local metal loss are identified and addressed. - At present, there is insufficient evidence to assess the distance a flaw has to be from an opening, so that the collapse pressure is unaffected by the presence of the opening. - The effect of external loads on the global collapse of the nozzle can be assessed on the basis of the guidelines given in BS 5500. However, the influence of external loads on the 'die away' length and local collapse of the ligament are unknown.				
Deliverable(s) relevant to FITNET A procedure based on BS 5500 has been developed for the assessment of corroded nozzles in pressure vessels.				
Contact details				
Name	Christoph Wiesner	Organisation	TWI	
Email	christoph.wiesner@twi.co.uk	Country	UK	
Comments				

3 General Themes

The following activity sheets were received.

- 3.1.1 Performance criteria for cold formed structural steel
- 3.1.2 Comparison of Model Tests and Full Scale Data with Theory
- 3.1.3 British Energy R6 Procedures
- 3.1.4 British Standards BS7910 Guide for assessing the significance of flaws in metallic structures
- 3.1.5 Extending Plant Life Through Improved Fabrication and Advanced Repair Methodology (ELIXIR)
- 3.1.6 PVRC JIP on Improved Weld Residual Stress Estimates and Local PWHT requirements
- 3.1.5 Extending Plant Life Through Improved Fabrication and Advanced Repair Methodology
- 3.1.6 PVRC JIP on Improved Weld Residual Stress Estimates and Local PWHT requirements
- 3.1.7 Life time management of transit oil and gas pipelines in Central and Eastern European countries, development of a multimedia-based expert system - LIMATOG
- 3.1.8 Optimisation of a welded spheric valve construction
- 3.1.9 Databank of failure case studies
- 3.1.10 German FKM Guideline "Fracture Mechanics Proof of Strength for Engineering Components"
- 3.1.11 Defect Assessment Software IWM VERB 7.0
- 3.1.12 Mechanics and its application to Technology
- 3.1.13 Activities of the European Pipeline Research Group (EPRG)

Title of Activity/Project:		
3.1.1 Performance criteria for cold formed structural steel		
Type of Activity		
To quantify effects of post processing methods of cold forming and hole punching on the integrity of structural steel products and to provide guidelines to optimise this process.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
36 Months	07/2000	06/2003
Summary		
Steel products are being subjected to an increasing amount of downstream processing in order to produce tailor made structural components quickly and cost effectively. Cold forming and hole punching are two such processes which offer flexibility to the designer and fabricator. However guidance on cold forming is currently limited to qualitative information related to the suitability of material while hole punching is subject to severe restrictions in many design codes. Concern over both processes stems from the potential increase in brittle-ductile transition temperature and the possible presence of incipient microcracking. The aim of the project is to derive guidance on the effects of cold bending and hole punching on material properties and to quantify the effect of this on subsequent structural integrity. Guidance for inclusion in Eurocode 3 will be produced as a final stage.		
Deliverable(s) relevant to FITNET		
• Quantification of effect of cold forming on mechanical properties of plates and sections • Quantification of performance of punched holes in beam-column connections and in fatigue • Recommendations for material specifications and design codes		
Contact details		
Name	Adam Bannister	
Organisation	Corus RD&T	
Email	Adam.bannister@corusgroup.com	
Country	UK	
Comments		

Title of Activity/Project:		
3.1.2 Comparison of Model Tests and Full Scale Data with Theory		
Type of Activity		
Comparison of full scale and model scale measurements and theoretical calculations in order to improve theoretical calculation methods.		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
23 Months	10/1999	08/2001
Summary		
Ships have not been used continuously in exposed west of Shetland locations. We still cannot predict the extreme response in large seas, where non-linear behaviour including intermittent wetting, wave slam and slap become very important. Since these forces affect the amount and distribution of structural strength that needs to be provided it is important that they are understood. Costs of slight under design can be very expensive. This project provides an opportunity to compare full and model scale measurements and theoretical calculations, and in conjunction with other projects to improve the theoretical calculation methods and through reliability calculation to determine appropriate safety factors for the different modes.		
Deliverable(s) relevant to FITNET		
Improved theoretical calculation methods, and comparison between the full scale and model scale measurements.		
Contact details		
Name	Professor N.D.P. Barltrop	Organisation University of Glasgow
Email		Country UK
Comments		

Title of Activity/Project:		
3.1.3 British Energy R6 Procedures		
Type of Activity		
Development of the R6 defect assessment procedures		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
	04/2002	continues
Summary		
The R6 Procedures are the subject of a continuing development programme involving British Energy, BNFL/Magnox and Serco Assurance (formerly AEA Technology). There is an ongoing research activity to develop R6. In 2002/03, the main areas of development are: • Leak-before-break advice; • Tearing-fatigue interactions (related to SMILE); • Treatment of secondary stresses; • Welding residual stresses; • Choice of collapse load (local or global); • Validation; • Generation of constraint solutions.		
Deliverable(s) relevant to FITNET		
Updated advice on limit loads. Updated advice on mixed mode fracture. Report on crack opening area and leakage rates. Updated residual stress compendium. Compendium of constraint parameters.		
Contact details		
Name: Bob Ainsworth Organisation British Energy Generation Ltd Email: bob.ainsworth@british-energy.com Country UK		
Comments		

Title of Activity/Project:			
3.1.4 British Standards BS7910 Guide for assessing the significance of flaws in metallic structures			
Type of Activity			
Revisions to the BS7910 flaw assessment procedures			
Duration:	Start	Nov 2001	Finish
			Dec 2005
Summary Revisions to BS7910 are under way in the context of further consolidation with SINTAP, R6 and Fitnet procedures (to be developed)			
Main ongoing procedure-writing activities are: 1. Restructuring of procedures taking into account progress in SINTAP, R6 and the German FKM procedures 2. Updates / re-writes / enhancement (within the new structure) of:- • Fracture and collapse assessment clause • Include SINTAP / R6 mismatch assessment • Include SINTAP / R6 constraint assessment • Include R6 crack arrest assessment • SIF / LL annex update • Corrosion assessment annex • Fatigue assessment procedure • Application to offshore structure • Residual stress distribution update • Include SINTAP NDT capability guidelines • Charpy correlation annex update • Fracture toughness estimation method review • Reliability and probabilistic aspects update			
Deliverable(s) relevant to FITNET			
Structure of revisions (already been submitted to relevant people)			
Contact details			
Name	Christoph Wiesner	Organisation	TWI
Email	christoph.wiesner@twi.co.uk	Country	UK
Comments			
BSI standardisation work			

Title of Activity/Project:

3.1.5 Extending Plant Life Through Improved Fabrication and Advanced Repair Methodology

Type of Activity: EC Growth Programme Project “ELIXIR”

Duration: 3 years **Start:** 01/2001 **Finish:** 12/2003

Summary

The General Objective is to increase the quality, competitiveness, efficiency, safety and reliability of industrial installations through the elimination of Intermediate Stress Relief in fabrication and fast standardised repair welding procedures for steel components used in industrial facilities.

The technical goals are:

1. Development of a new Hydrogen diffusion model for high strength steels
2. Development of new material models for simulation of Residual Stress development during welding
3. Development of Non-Destructive low cost ACSM & Laser RS measurement technique
4. Guidelines for the use of weld simulation techniques as an engineering tool

Deliverable(s) relevant to FITNET

- ☐ Advanced simulation procedures for fabrication & repair welds
- ☐ Guidelines for elimination of intermediate PWHT in industrial fabrication
- ☐ Fast repair methodology without PWHT
- ☐ Structural integrity assessment of industrial components

Contact details

Name: George Vinas **Organisation** Mitsui Babcock Technology

Email: gvinas@mitsuibabcock.com **Country:** United Kingdom

Comments

Title of Activity/Project:			
3.1.6 PVRC JIP on Improved Weld Residual Stress Estimates and Local PWHT requirements			
Type of Activity	Joint industry project with 17 international petrochemical and nuclear companies		
Duration:	Start (mm/yyyy)	Nov. 00	Finish (mm/yyyy) Nove, 04
Summary 1. Develop consistent residual stress distributions for a broad range of pressure vessel and pipe welds 2. Develop unified parametric descriptions of the residual stress distributions 3. Develop guidelines for considering both uniform and local PWHT in assessing residual stress redistributions and reductions after treatment 4. Develop recommendations for ASME and API future code revisions 5. Develop detailed local PWHT guidelines for avoiding detrimental temperature gradients and effective reduction of weld residual stresses 6. Develop fatigue and fracture driving force calculation procedures fro appropriate treatment of weld residual stresses			
Deliverable(s) relevant to FITNET Detailed guidelines and recommendations in the above six areas for future ASME and API code revisions			
Contact details			
Name	Pingsha Dong	Organisation	Battelle
Email	dongp@battelle.org	Country	U.S.A.
Comments			

Title of Activity/Project:			
3.1.7 Life time management of transit oil and gas pipelines in Central and Eastern European countries, development of a multimedia-based expert system - LIMATOG			
Type of Activity	International research project		
Duration:	Start (mm/yyyy)	01/1996	Finish (mm/yyyy) 12/1998
Summary The main aim was to develop an expert system for life time management of gas and oil pipelines. An expert system suitable for the evaluation of the safety of large-diameter transit oil and gas pipelines was elaborated within the framework of an international co-operation, with the support of the INCO-COPERNICUS program. The activity of the researchers of seven countries (UK, Austria, Poland, the Ukraine, Belarus, Bulgaria and Hungary) was co-ordinated by the contracting party (University of Bradford, England) and BAYLOGI as the technical co-ordinator. Defect evaluation methods and their application conditions were collected and analysed, as well as a large number of data needed for the database of the expert system. The research results of the different countries concerning transit gas and oil pipelines were summarised. A large number of data (material characteristics, geometrical parameters, operation conditions) relating to the pipelines operating in the different countries were collected and entered into a database, and repairing technologies and useful life time management methods of the pipelines having different types of defects were elaborated.			
Deliverable(s) relevant to FITNET A commercial software was elaborated for life time management of transit gas and oil pipelines. The “test run” of the software system evaluating the effect of the different defects in the pipelines (damages, corrosion craters, geometrical defects and cracks) on the conditions of safe operability was realised on a 100 km long pipeline section of MOL Rt. and TRANSNEFTEDIAGNOSTIKA (Gomel, Belarus) each.			
Contact details			
Name	Dr. László Tóth	Organisation	Bay Zoltán Institute for Logistics and Production Systems
Email	Tlaszlo@alpha.bzlogi.hu	Country	Hungary
Comments			

Title of Activity/Project:			
3.1.8 Optimisation of a welded spheric valve construction			
Type of Activity		Industrial R&D contract	
Duration:		Start (mm/yyyy)	Finish (mm/yyyy)
		01/2000	12/2002
Summary			
The DKG East Plc. company developed a new welded construction for large-sized (18", 36" and 48" in diameter) spheric valve. The aim of the project is to carry out the fracture mechanical and strength analysis of the spheric valve construction taking into consideration the possible loading conditions during operation, to optimise the construction of the welded spheric valve, in order to start the series production of a new product group. The two-year project is realised within the scope of a successful OM KFHÁ applied R&D tender. The results were the following: - determination of the operational loading conditions of the different parts of the spheric valve, and the loading conditions of the spheric valve during opening and closing process, finite element modelling of the shrink-fitting of the valve body; determination of the stresses arising during shrink-fitting; - determination of moment of rotation and its changing during opening-closing process; - strength and fracture mechanical analysis of the welded joints of the house parts and ball-bearings, and on the basis of this the determination of the critical defect sizes; - elaboration of a reliable, non-destructive testing method of the joints, the testing of the calculation on prototype by measurement.			
Deliverable(s) relevant to FITNET			
Methodology for evaluating crack like defect in a spheric valve.			
Contact details			
Name	Dr. Gyöngyvér B. Lenkey	Organisation	Bay Zoltán Institute for Logistics and Production Systems
Email	lenkey@bzlogi.hu	Country	Hungary
Comments			

Title of Activity/Project:			
3.1.9 Databank of failure case studies			
Type of Activity		Industrial R&D contract	
Duration:		Start (mm/yyyy)	Finish (mm/yyyy)
		10/2000	05/2001
Summary			
The aim of the project is to develop a software suitable for handling the data of a collection of failure cases at TVK Plc., to establish a background knowledge database, to upload the necessary data and to make multimedia CD introducing the company. The result is a databank that can be used in the field of structural integrity, and if it will be developed even further, it would provide the demonstrational basic database of an educational centre established jointly with the client. The result is a multimedia / data providing CD, and an information and communication WEB-site. The development of the WEB-site of the Department for Structural Integrity within this system means the foundation of the establishment of an information centre in Eastern Hungary. It is also among the objectives of other projects. A curriculum, which can also be used in remote education, will be prepared, and it can be used within the frames of the lifetime education of engineers.			
Deliverable(s) relevant to FITNET			
Software of failure case studies databank. Teaching aids concerning typical failure modes.			
Contact details			
Name	Dr. László Tóth	Organisation	Bay Zoltán Institute for Logistics and Production Systems
Email	tlaszlo@alpha.bzlogi.hu	Country	Hungary
Comments			

Title of Activity/Project:		
3.1.10 Software for the German FKM Guideline “Fracture Mechanics Proof of Strength for Engineering Components”		
Type of Activity		
To support the user of the guideline an accompanying software is being developed in the framework of a FKM project by Fraunhofer Institut für Werkstoffmechanik and Institut für Werkstoffkunde TU Darmstadt		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
19 Months	01/ 02	07/03
Summary		
The guideline covers the assessment of components under static loading with respect to crack initiation, stable crack growth, crack instability and plastic collapse and the assessment of components under cyclic loading with respect to fatigue strength and fatigue crack growth. The document is compatible to the European guideline SINTAP regarding the failure assessment procedures and to the British Standard 7910 regarding the fatigue crack growth calculations. It is a complement to a guideline on proof of static and fatigue strength with conventional methods developed in another project of FKM. The structure of the FKM Guideline follows the path from the problem statement to the assessment of results. The software FracSafe being developed has the same structure as the guideline. For components under static loading FracSafe uses FAD in displaying the results. Additionally reserve factors can be calculated and parameter study can be done. For cyclic loading the number of cycles, the final or the initial crack size can be calculated for constant or variable amplitude loading. Regarding calculation procedures for static loading FracSafe covers a subset of SINTAP procedures. The user can chose English or German language for input and output.		
Deliverable(s) relevant to FITNET		
Could be used in WP7 – Training and Education		
Contact details		
Name	Organisation	
Dr. Ludvik Hodulak	Fraunhofer Institut für Werkstoffmechanik	
Dr. Brita Pyttel	Institut für Werkstoffkunde TU Darmstadt	
Email	Country	
Ludvik.hodulak@iwm.fhg.de	Germany	
pyttel@mpa-ifw.tu-darmstadt.de	Germany	
Comments		

Title of Activity/Project:		
3.1.11 Defect Assessment Software IWM VERB 7.0		
Type of Activity		
IWM VERB is an easy-to-use software for fast assessments of metallic components with defects. It is a tool based on linear-elastic and elastic-plastic fracture mechanics (FAD and GE/EPRI method).		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
Summary		
This PC software has been developed and used successfully since many years at Fraunhofer-Institut für Werkstoffmechanik (IWM). It can be used to calculate safety margins for given cracks and loads, critical crack sizes, critical loads, fatigue crack growth and leak areas. Solution methods and models of cracked components used in IWM VERB are frequently updated and extended to utilise recent developments of defect assessment methods. Version 7.0 of IWM VERB uses assessment levels and many calculation procedures of SINTAP and is compatible to German guideline "Bruchmechanischer Festigkeitsnachweis für Maschinenbauteile". Areas of application are: assessment of safety and availability of components, estimation of life time, leak-before-break analyses, determination of inspection intervals and of requirements for non-destructive examination, choice and qualification of materials for structures and plants.		
Deliverable(s) relevant to FITNET		
Contact details		
Name Dr. Ludvik Hodulak Organisation Fraunhofer-Institut für Werkstoffmechanik		
Email ludvik.hodulak@iwm.fhg.de Country Germany		
Comments		

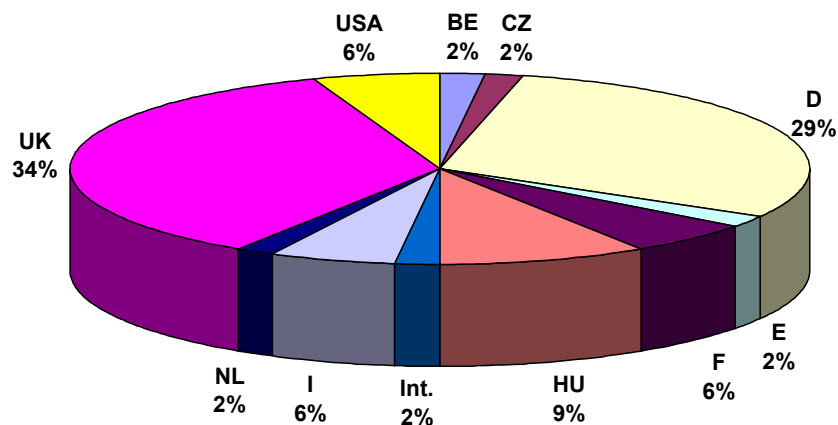
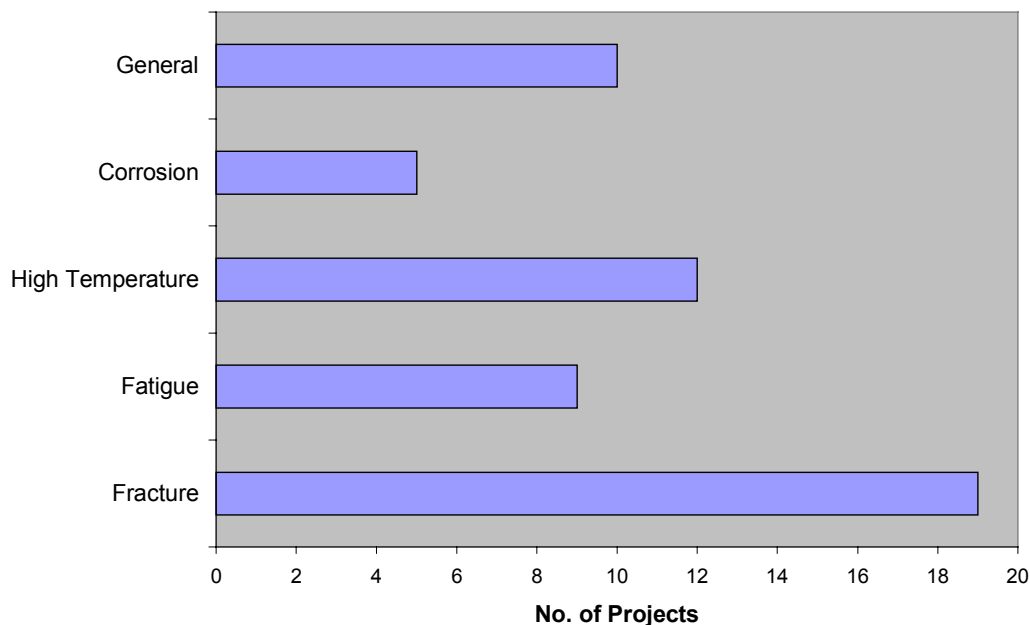
Title of Activity/Project:		
3.1.12 Mechanics and its application to Technology		
Type of Activity		
No. A0083 All Russian Program "Integration"		
Duration:	Start: 1997	Finish: 2001
Summary		
Modelling of interface fracture nucleation and growth was performed taking into account non-linear interface bonding. A two-parameter criterion of interface crack growth was suggested. An analytical solution of the interface crack problem in the case of a piece-wise linear bond deformation law was obtained. Numerical analysis of the adhesion fracture toughness dependence on the bonding parameters and elastic properties of joined materials was performed on the basis of solving the system of integro-differential equations.		
Deliverable(s) relevant to FITNET		
Contact details		
Name Prof. R. Goldstein	Organisation Institute for Problems in Mechanics Russian Academy of Sciences	
Email goldst@ipmnet.ru	Country Russia	
Comments		
Details communicated by Sergei Alexandrov		

Title of Activity/Project:		
3.1.13 Activities of the European Pipeline Research Group (EPRG)		
Type of Activity		
Duration:	Start(mm/yyyy)	Finish(mm/yyyy)
Summary		
Research project currently being undertaken by the Fracture Working Group: • Mechanical damage assessment for low toughness pipes • Linepipes for sub-sea applications • Fatigue assessment of linepipes and effect of mean stress • Development of high strength X100 linepipe steel • Fracture arrest in small diameter pipes		
Deliverable(s) relevant to FITNET		
Contact details		
Name Vinod Chauhan	Organisation Advantica Technologies	
Email vinod .chauhan@ advanticatech.com	Country UK	
Comments		

Title of Activity/Project:								
3.1.14 German FKM Guideline “Fracture Mechanics Proof of Strength for Engineering Components II”								
Type of Activity								
Duration: 24 Months	Start 04/ 03	Finish 03/05						
Summary The guideline, which was issued in 20001, covers the assessment of components under static loading with respect to crack initiation, stable crack growth, crack instability and plastic collapse and the assessment of components under cyclic loading with respect to fatigue strength and fatigue crack growth. The document is compatible to the European guideline SINTAP regarding the failure assessment procedures and to the British Standard 7910 regarding the fatigue crack growth calculations. The structure of the FKM Guideline follows the path from the problem statement to the assessment of results. The extensions are being done in the areas of - probabilistic fracture mechanics - mixed mode - dynamic loading - fatigue - stress crack corrosion. Also extended will be the compendium of material data and additional examples of application will be included.								
Deliverable(s) relevant to FITNET								
Contact details <table border="0"> <tr> <td>Name</td> <td>Organisation</td> </tr> <tr> <td>Dr. Brita Pyttel Dr. Michael Luke</td> <td>Institut für Werkstoffkunde TU Darmstadt Fraunhofer Institut für Werkstoffmechanik</td> </tr> <tr> <td>Email michael.luke@mpa-ifw.tu-darmstadt.de pyttel@mpa-ifw.tu-darmstadt.de</td> <td>Country Germany</td> </tr> </table>			Name	Organisation	Dr. Brita Pyttel Dr. Michael Luke	Institut für Werkstoffkunde TU Darmstadt Fraunhofer Institut für Werkstoffmechanik	Email michael.luke@mpa-ifw.tu-darmstadt.de pyttel@mpa-ifw.tu-darmstadt.de	Country Germany
Name	Organisation							
Dr. Brita Pyttel Dr. Michael Luke	Institut für Werkstoffkunde TU Darmstadt Fraunhofer Institut für Werkstoffmechanik							
Email michael.luke@mpa-ifw.tu-darmstadt.de pyttel@mpa-ifw.tu-darmstadt.de	Country Germany							
Comments								

4 Summary and Further Work

A collation of on-going R&D projects relevant to the development of fitness-for-service procedures has been made, based on the input received from the members of the FITNET Thematic Network. The number of responses received per area and their geographic distribution (based on the nationality of the contact person) is shown in the plots below. There is a reasonable spread across the working areas, although it is noticeable that fracture is clearly the area of largest interest. The response for the corrosion area appears weak. The biggest response in terms of countries was from Germany and the UK. There was surprisingly little input from several industrialised countries with traditional interest in FFS, for instance France and Sweden.



This collation of data will be used in the review of FFS procedures, together with the on-going survey of needs for this technology and the existing reports available to the group. In regard to the latter, the following are noted:

- PLAN Report, Defect Assessment Procedures for Plants, B. Dogan, GKSS, October 2001
- Die industrielle Anwendung bruchmechanischer Konzepte vor dem Hintergrund internationaler Bertungsvorschriften und Regelwerke, Zerbst & Langenberg, GKSS 2000/38
- PVP Journal Vol 77 Nos 14-15 2000, Special Issue "Flaw Assesment Methods"
- Comprehensive Structural Integrity, vol. 7 Practical Fracture Assessment Methods, Elsevier, 2003