COOPERATIVE RESEARCH CENTRE FOR WELDED STRUCTURES

2001 / 2002

ANNUAL REPORT

Annual Report
2001 / 2002

CRC AUSTRALIA

Established and supported under the Australian Government's Cooperative Research Centres Program

CRC-WS

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Introduction by the Chairman & CEO

Mr Rod Keller
Chairman
CRC-WS

Dr Colin Chipperfield
Chief Executive Officer,
CRC-WS

The past year (2001/02) has been one of great significance for the Cooperative Research Centre for Welded Structures (CRC-WS). It has been a year in which the research quality and operations of the Centre were given high endorsement by independent and Government-appointed Review Teams, as part of our Second Year Review; the Centre also made significant steps forward in its demanding quest for self-sufficiency by commencing the commercialisation process for two significant items of intellectual property; the Board and Management have also identified additional strategies and plans for the future of the Centre, culminating in a joint submission (with several CRCs and CSIRO) to the CRC Committee and Government in the 2002 CRC Submission Round.

The CRC-WS was the subject of a Research Quality Review as part of the Centre's Second Year Review in August 2001. This independent (Stage 1) review was conducted under the Chairmanship of Professor Ian Polmear.

Professors Graham Hutchinson, Bob Apps, Ian Polmear & Greg Tegart

It was very gratifying to receive the Review Report which fully endorsed the focus, quality and emphasis of our R&D program. In short, the Review Team concluded that:

a. The overall quality of the research was judged to be of excellent international standing;

b. Research management strategies were also judged to be excellent;

c. Research facilities with respect to laboratory and industrial equipment are impressive and appropriate to underpin the research programs;

d. CRC-WS management is committed and very competent.

The reaction by the Review Team to the work on technology transfer was very positive with the team stating on a number of occasions that the work was "most impressive". These conclusions were generally echoed and supported by the Government-appointed Stage 2 Panel headed by Mr John Marshall. It was most pleasing to receive such endorsements concerning research quality, Centre management and research management strategies and general operations.

During the year, the CRC-WS made its first steps towards commercialisation, initially with the licensing of its world-first, distance education course for Welding Engineers to Cranfield University. Cranfield have been granted the exclusive rights for delivery of the course throughout Europe and plan to commence the course in October 2002. The CRC-WS and Cranfield will cooperate and share improvements to the course as they unfold.

Colin Chipperfield & Stephen Blackman signing contract

The year also saw the patenting and world-first demonstration of the Centre's "Phoenix" technology. The technology, which delivers significant advantages to MIG and other welding processes, has led to the formation of a separate company, JoinTechnology Pty Ltd, whose charter is to commercialise this "Phoenix" technology. During the year, that company successfully applied for a COMET Grant and, at the time of writing, is finalising a commercialisation strategy and business plan with the assistance of Invetech. It is envisaged that 2002/03 will be a big year for the "Phoenix" technology and the fledgling company, JoinTechnology Pty Ltd.

In its Strategic and Business Plans, which were revisited, reviewed and revised during the year, the Centre sees intellectual property as the key to its self-sufficiency. Innovations such as the Welding Engineers Distance Education Course and "Phoenix" are of the utmost importance to the Centre and this is leading to an enhanced emphasis on commercialisation in the coming year. The Centre is particularly pleased that, during the year, Dr Brian Oldland of FTS Technology Services accepted an invitation to join the Board of the CRC-WS as Independent Director. Brian has a background and expertise in Research, Welding Technology, Business Development and Commercialisation.

Introduction by the Chairman & CEO

Clearly, the discovery of new, potential IP to supplement future revenues depends on the success and emphasis of our Research program. Key aspects of the Centre's R&D portfolio during 2001/02 were:

- The commencement in July 2001 of the Centre's three-year, $1m per annum Power Generation R&D program which is sponsored by ten (10) Power Generation Stations from Queensland, NSW, Victoria and the Northern Territory.

- The continuation of the Centre's $1m per annum Pipeline program which is sponsored by fourteen (14) companies from across Australia.

- Further, important initiatives in the Defence, Mining (Alumina) and Power industries.

- Significant contributions made to SMEs through advice, contract research and through other mechanisms such as activities co-sponsored by the Victorian State Government and the CRC-WS.

The uptake of new knowledge and Centre IP by Australian industry is clearly assisted by such sponsorship, linkages and recognition. It is significantly further enhanced by the Centre's integrated Technology Transfer program which is championed by the Welding Technology Institute of Australia (WTIA). The Centre benefits from access to the needs of over 1,000 member companies as well as individual members of the WTIA and the Australian Pipeline Industry Association (APIA). In return, the Centre and its Core Participants provide a resource for industry problem solving and knowledge of world-wide best practice and innovation.

A study tour to the USA, arranged by WTIA during April 2002, served to extend these linkages by involving four (4) key CRC Researchers on tour. Visits were focussed on leading research institutions involved in Welded Structures research. As a result, it is likely that the Centre's 2002/03 research portfolio will include two trans-Pacific, collaborative research projects.

Dinner with EWI Staff

In addition, linkages with key pipeline research organisations in the USA (the Pipeline Research Council International (PRCI)) and Europe (the European Pipeline Research Group (EPRG)) have also been invigorated, largely as a result of the contribution being made by the Centre to the pipeline industry.

During the year, the CRC-WS also entered into Memoranda of Understanding with Chosun University (Korea), Osaka University (Japan) and Cranfield University (UK).

The above developments achieved during 2001/02 attest to the significant, further expansion, development and achievements of the CRC-WS during the past year. These key achievements have been in the areas of research quality, operational efficiency, commercialisation and international linkages and recognition. It is particularly pleasing to also note, as far as research quality is concerned, that for the year, milestone achievement across our total research portfolio was 79%, precisely in line with our Business Plan aims and almost double the milestone achievement rate (of 46%) achieved in 1998/9 (three years ago).

Management of the CRC for Welded Structures changed significantly during the year. Following the sad and untimely death of Chairman Dr Don Williams early in the year, it was decided to form an Executive Committee of the Board. This new Committee has two representatives each from the Research Providers and Industry Core Participants of the Centre and has subsumed the role of the previous Audit Committee. It is believed that this enhanced oversight of a Board committee in the operations of the CRC for Welded Structures is appropriate given the current rapid development of the Centre.

R Keller
Chairman

CG Chipperfield
Chief Executive Officer

Footnote

It is with thanks and appreciation that we record the contribution of several major, recently departed contributors to the Board and/or CRC-WS operations. During the year, Mr Cec Stubbs resigned as Deputy Chairman; Mr Leigh Fletcher, the previous CEO and subsequent Board member, resigned as TWI representative; and Mr Max Conyngham, who has worked on our Education program almost since its inception, retired on 30th June 2002.

It is also with sadness that we herewith advise of the death of Mrs Monica Thomas who worked at the Centre as Administrative Assistant for eight years prior to her resignation due to ill health.

Monica Thomas

Their contribution to the CRC-WS is gratefully acknowledged.

Structure and Management

The Centre is registered as an incorporated company, limited by guarantee and without share capital - CRC for Welded Structures Limited, ACN 058 890 412 under Division 1 of Part 2.2 of the Corporations Law of New South Wales. The registered Head Office of the CRC-WS is the Illawarra Technology Centre at the University of Wollongong.

All of the Core Participants listed on the back cover of this Annual Report are members of the incorporated CRC. The only exception is DSTO, whose status at Board meetings is that of Observer.

The Centre and Commonwealth Agreements for the CRC-WS were executed on the 15th September 1999, modified to include Woodside Energy and Agility on 19th September 2000 and OneSteel on 9th July 2001.

Board of Directors

The management of the Centre is undertaken through a Board of Directors which comprises one nominee from each of the Core Participants. In addition, the Board includes an independent Chairman (Mr Rod Keller), an independent Director (Dr Brian Oldland) and the Centre's Chief Executive Officer. The composition of the Board is shown on the following page. Details of Directors, their Alternates and their attendances are given in the accompanying financial statements of the incorporated company.

Since the last report, there have been some changes to the membership of the CRC-WS Board. It is with sadness we note the sudden death of our former Chairman, Dr Don Williams, in August last year. Mr Rod Keller resigned his position as APIA representative on the Board and was subsequently re-elected as an Independent Director and Chairman of the Board. Other changes consist of the inclusion of Dr George Collins (ANSTO) and Ian Haddow (representing APIA). Dr Collins is Director of the Materials Division at ANSTO having been promoted to the position from which Dr Adam Jostsons resigned in mid December, whilst Ian Haddow is General Manager Technical at the Australian Pipeline Trust replacing Rod Keller as APIA's representative on our Board. Mr Tom Bryant from Pacific Power resigned from the CRC-WS Board following a restructure at Pacific Power International and Mr Barry Finlay, now General Manager Technical Services at Pacific Power, took his seat on the Board. Dr Brian Oldland was also appointed to our Board as an Independent Director and attended his first Board Meeting on 12th June 2002. We welcome our new Directors and are sorry to farewell Leigh Fletcher who has resigned both as representative for TWI on the Board and the representative for Agility on the Research Management Committee. The Board met four times during the year, rotating the venue in order to visit the operating centres or nodes of the Centre. Meetings were held on the following dates and at the geographical locations indicated.

Date	Venue
21/08/01	COGE University of Western Australia
04/10/01	University of Wollongong
21/02/02	CSIRO MST, Melbourne
12/06/02	ANSTO, Sydney

Executive Committee

The Executive Committee was formed subsequent to a Board Meeting in February 2002 to oversee the management of the business activities, business processes and governance of the CRC-WS and to provide recommendations to the Board and management of the CRC-WS. It has subsumed the role of the Audit Committee which has been disbanded. Members of the Executive Committee represent both Research Provider and Industry Core Participants of the CRC-WS (see accompanying table).

Management

The Head Office of the Centre is located within the Illawarra Technology Centre of the University of Wollongong. Full-time Head Office staff are the Chief Executive Officer, Dr Colin Chipperfield, Mr Sangarapillai Suntheraraj (Finance Manager and Company Secretary) and Mrs Mary Baker (Administrative Assistant). Dr Keith Enever is the Centre's Research Program Manager whilst Mr Max Conyngham joined the Centre as its Education Program Manager. Dr Enever and Mr Suntheraraj are ably assisted, on a part-time basis by Mr Long Nguyen and Mrs Lorraine Shotton respectively (see accompanying table).

Research Management Committee

The role of the Research Management Committee is to assist and advise the CEO on the project and sub-program issues, emphases and priorities and to provide a forum for technical interchange and management interaction at the project operational level. The Research Management Committee (see accompanying table) includes representatives from each Core Participant and thereby facilitates cross-participant and cross-program interaction. Five meetings of the Management Committee were held during the financial year as follows:

Date	Venue
27/09/01	University of Wollongong
28/11/01	University of Sydney
14/03/02	CSIRO, Adelaide
02/05/02	University of Wollongong
30/05/02	IRIS, Melbourne

THE BOARD OF DIRECTORS

Don Williams
Rod Keller
Chairman
Independent

Colin Chipperfield
Chief Executive Officer

Neil Cain AGL-C	**Adam Jostsons** **George Collins** ANSTO	**Rod Keller** **Ian Haddow** APIA	**Jim Williams** BHP Steel
Rick Kuebler CIGWELD	**Ian Sare** CSIRO MST	**Bob Phillips** DSTO	**Tom Bryant** **Barry Finlay** Pacific Power
Bob John TWI	**Ian Young** **Robert Smith** Univ Adelaide	**Judy Raper** Univ Sydney	**Beverley Ronalds** Univ Western Australia
Jim White OneSteel	**Peter Robinson** Univ Wollongong	**Rob Male** Woodside Energy	**Chris Smallbone** WTIA

Brian Oldland
Independent

The Board of Directors of the CRC for Welded Structures as at the February 2002 Board Meeting

EXECUTIVE COMMITTEE

Rod Keller
Chairman

Keith Enever Research Program Manager	**Colin Chipperfield** CEO, CRC-WS	**S Suntheraraj** Finance Manager & Company Secretary
Peter Robinson Univ Wollongong	**Ian Sare** CSIRO	**Ian Haddow** Australian Pipeline Trust

Brian Oldland FTS Technology Services	**Chris Smallbone** WTIA

STAFF

Colin Chipperfield
Chief Executive Officer

Keith Enever Research Program Manager	**Mary Baker** Administrative Assistant	**S Suntheraraj** Finance Manager & Company Secretary
Long Nguyen IPMIS Programmer	**Max Conyngham** Education Program Manager	**Lorraine Shotton** Accounts Clerk

RESEARCH MANAGEMENT COMMITTEE

Colin Chipperfield
Chairman

S Suntheraraj Finance Manager Secretary	**Keith Enever** Research Program Manager

Leigh Fletcher **Kees Hoogesteger** AGL-C	**Andrew Croker** ANSTO	**Allen Beasley** APIA	**Frank Barbaro** BHP Steel
Rick Kuebler CIGWELD	**Nasir Ahmed** CSIRO	**Bob Phillips** DSTO	**Bob Small** Pacific Power
Valerie Linton Univ Adelaide	**Greg Hancock** Univ Sydney	**Manolis Fakas** Univ Western Australia	**John Norrish** Univ Wollongong
Milan Brandt IRIS	**Alistair Forbes** WTIA	**Hayden Dagg** **John Piper** OneSteel	**Michael Brameld** Woodside Energy

Cooperative Linkages

The number and extent of the Centre's cooperative linkages continues to be a major strength of the CRC-WS. Such cooperative interactions have been extended, during the year, to international collaborators, new domestic sponsors and partnerships and a particularly exciting proposal, recently put forward to Government, involving an alliance between three CRCs and CSIRO to form a global R&D business called the Australian Metals Manufacturing Centre of Excellence.

Such cooperative links are enhanced by the Centre's website (www.crcws.com.au) and its web-based Integrated Project Management Information System (IPMIS), which was highly praised during the Centre's Second Year Review. The IPMIS system permits world-wide access to project information by sponsors, researchers and other accredited stakeholders and includes project plans, quarterly reports, milestone performance data and progress summaries.

Core Participant Cooperation

Table 1 provides a listing of the major R&D projects performed under the Centre's 2001/2 approved budget and subprogram portfolio. The table also shows each of the Centre's Core Participant Organisations and those projects in which each Core Participant has a significant involvement. The table also includes the Industrial Research Institute Swinburne (IRIS), since this organisation joined the Centre as a Research Associate member during the year. The high level of cooperation between the Core Participants of the Centre is emphasised by noting that, from Table 1, the average number of Core Participants involved in each project is 2.9. This is somewhat less than the corresponding figures of 3.6 and 3.3 achieved in 2000/1 and 1999/00 respectively, but still highlights a substantial level of interaction and joint project activity: the reduction is, in large part, due to the Centre's increased emphasis on commercialisation of intellectual property (IP) which, in some cases, has required project activity to become more focussed and restricted (in both a business and geographic sense).

High levels of Core Participant cooperation have been particularly noteworthy in the Pipeline and the new Power Generation research sub-programs and in the "X80 Steel for ANZAC" and the "Weld Metal Cracking in Flux Cored Arc (FCA) Welded Thick Plate" projects. For example, nine (9) Core Participant organisations are involved in the Centre's Pipeline research sub-program, while five Core Participant organisations are involved in both the above projects.

At the other end of the spectrum, CSIRO was charged with the research responsibility of extending the patented "Phoenix" technology and the conduct of "proof of concept" trials.

Thus the number of Core Participants involved in each of the CRC's 2001/2 R&D projects ranged from 1 to 5 and averaged 2.9.

Non-Core Participant Cooperation

During 2001/2, the CRC for Welded Structures attracted significant cash and in-kind support from program-specific and project-specific sponsorship. Program-specific sponsorship was mainly forthcoming for the Centre's Pipeline research sub-program (which received cash sponsorship either directly or via APIA from 14 companies) and the Power Generation research sub-program (which received cash sponsorship directly from 10 individual Power Stations from Queensland, NSW, Victoria and the Northern Territory). Project-specific cash sponsorship arose from forums such as WTIA Panel meetings, a Victorian Government-sponsored project on "Laser Processing" or contract work conducted on a fee-for-service basis.

In all and over and above Core Participant contributions, cash sponsorship was received from 36 companies during 2001/2 and special thanks are extended to the following companies:

Agility Team Build, Alinta Gas, Bogaart, Bredero Shaw Australia, CS Energy, Delta Central Coast, Delta Western, DSTO-AMRL, Duke Energy, Envestra, Epic Energy, Eraring Power Station, ESAB Australia, GCI-Kenny, Goodwill Games, GPU GasNet, Ground Support Services, Hazelwood Power, Industrial Research Institute Swinburne, JP Kenny, Lincoln Electric, Loy Yang Power, MJ Kimber Consultants, McConnell Dowell Constructors, Meanderlyn, Microalloying International, Nabalco, OneSteel Pipe & Tube, Origin Energy, Peter Tuft & Associates, Stanwell Corporation, Tarong Power, Tenix Defence Systems, Tyco Water, Venton & Associates and Worley.

In many of these cases, and particularly in the case of the Pipeline and Power Generation sub-programs, the CRC-WS held quarterly meetings of sponsor groups to assist in the direction and guidance of the research projects and to ensure quality and timely outputs. These meetings (called Program Management Committee or PMC meetings) were chaired by an industry nominee and held in a research or industrial location of relevance to the work.

Photo depicts the last Power Generation PMC meeting for 2001 which took place at ANSTO in September.

The PMC meetings generally include formal presentations by CRC-WS researchers and feedback by nominated industry project advisers and other sponsors. Following each PMC meeting, the CRC-WS circulates a CD containing all presentations made on the day, as a permanent record of progress and the proceedings. Comprehensive project reports and literature surveys are also circulated to the sponsor group in a similar manner, when available.

Table 1

CORE PARTICIPANT COOPERATION																		
Projects	UoW	UoA	UoS	UWA	ANSTO	CSIRO	DSTO	Pacific Power	WTIA	CIGWELD	APIA	BHP	OneSteel	Agility	Woodside	TWI	IRIS	Sub-Program
Mechanised Girth Welding	●	●									●	●						Pipeline
Hot Cracking/Stress in Girth Welds	●					●					●							
Pipeline Resistance				●							●							
Pipeline Awareness	●										●							
Pipeline Fracture Risk		●				●					●	●		●				
Pipeline Strength Testing					●						●		●	●				
Joint Coating Adhesion	●										●		●					
S-Deposition				●							●							
Arc Blow	●												●	●				
Simulation of Pipeline Construction						●							●	●				
Optimised Arc Welding	●									●								Joining Equipment
Technology of Wire						●				●								
Tin Mill Weld Monitoring	●											●						
Flash Butt Weld Monitor	●											●						
Postweld Heat Treatment	●				●			●	●									Power Generation
High Energy Piping	●				●			●	●									
In Situ Laser Surfacing						●		●	●								●	
Turbine Valve Spindle Coating	●				●			●	●									
In Situ Weld Repair	●							●	●									
Repair Methodologies					●			●	●									
Surface Engineering	●	●							●									Mining
Railway Bridge Assessment	●				●													Building & Construction
Weldability of Mg Alloys		●														●		
Friction Welding		●				●										●		
Processing of Degraded Airframes		●					●											
X80 Steel for ANZAC	●	●					●					●						
WMC in FCA Welded Thick Plate	●						●		●	●		●						
Coated Steel Welding	●											●	●					
Platform Design & Integrity				●											●			
Equal Width Rectangular Hollow Sections			●						●				●					
Strength of Point Fasteners			●									●	●					
Roof & Wall Systems			●									●						
Expert System for Welded Structures	●	●										●						
GMAW Fume Formation	●	●							●									OH&S
Project Phoenix						●												

Cooperation with other CRCs

A key development during 2001/2 has been the concept of an "Australian Metals Manufacturing Centre of Excellence" (AMMCOE). This exciting proposal, which essentially seeks to combine the resources of the CRCs for CAST metals manufacturing, Intelligent Manufacturing Systems and Welded Structures, together with relevant sections of CSIRO, was submitted to Government in the latest (May 2002) CRC Selection Round. If approved, the combined entity will seek to become a global provider of metals manufacturing solutions, utilising the combined resources of the partners and additional expertise.

The concept of AMMCOE emerged from a series of wide-ranging discussions between the CEOs and/or Chairmen of the proponent organisations, culminating in the preparation of a detailed business case and a world-wide review of metals manufacturing R&D.

International Linkages

International interactions and links provide an invaluable opportunity to benchmark and calibrate the activities of the Centre against world's best. Such linkages are already available through the CRC's Core Participants, such as through Woodside Energy to Shell (Holland) or through DSTO to other Defence Departments around the world, but additional beneficial relationships have also developed during 2001/2.

APIA and the CRC-WS have jointly developed a relationship with two trans-Atlantic organisations which have a long and distinguished history of collaboration in the field of Pipeline research, namely the Pipeline Research Council International (PRCI) (in the USA) and the European Pipeline Research Group (EPRG). Both PRCI and EPRG have provided APIA and the CRC-WS with the opportunity to present up to 5 technical papers at the 2003 Berlin Conference of the PRCI/EPRG.

Left to right: Max Kimber (M.J. Kimber Consultants Pty. Ltd. and Chairman of the Pipeline PMC), Bill Bruce (Edison Welding Institute, USA) and Dr Colin Chipperfield (CRC for Welded Structures)

Furthermore, 2002/3 is likely to see the first trans-Pacific pipeline research project on In-Service Welding, to be conducted in the USA by EWI and at the CRC-WS by the University of Wollongong. Sponsors of the project are likely to be the CRC-WS, APIA, WTIA, the Australian Pipeline Industry, EWI and PRCI. A further, separate project involving the CRC-WS, the University of Wollongong, EWI, Cranfield University and industry sponsors is in the planning stage and will be the subject of an industry launch meeting in Houston in the latter half of 2002.

Such plans and discussions on future projects were assisted by the visit of CRC Partner representatives to the USA in April 2002. The visit was arranged by WTIA and included visits by Drs Colin Chipperfield (CRC-WS) and Nasir Ahmed (CSIRO), Mr Chris Smallbone (WTIA) and Professors Valerie Linton (University of Adelaide) and John Norrish (University of Wollongong) to EWI, the Colorado School of Mines, the Electric Power Research Institute and Oak Ridge National Laboratories.

The Research Tour group at the Oak Ridge National Laboratories, USA

In addition, the CRC-WS has sought to extend its formal international links, focussing in particular on those linkages which provide a clear business or technical opportunity for the Centre. In the past year, the CRC-WS has renewed its Memorandum of Understanding (MOU) with Osaka University, Japan and initiated an MOU with Cranfield University in the United Kingdom. In addition, the Centre has licensed its distance learning, Welding Engineer Course to Cranfield University, who will commence course delivery in October 2002.

Colin Chipperfield with Stephen Blackman (Cranfield University) (left)

Research Program

The Research Program of the CRC for Welded Structures is composed of six main sub-programs, these being in the areas of "Pipeline Technology", "Joining Equipment and Consumables", "Power Generation and Petrochemical", "Mining and Minerals Processing", "Building and Construction" and, finally, "Health and Safety". The benefits being targeted by this Research Program have been estimated by industry as totalling at least $400m, a breakdown for which is given in the adjacent table. Added to which, eminent medical researchers have estimated the cost of treating welding fume-induced industrial asthma and hence the potential value of the OH&S R&D projects at $100m. While it is anticipated that this latter figure represents only a fraction of the real health cost of welding fume, the figure does provide additional incentive and support for the Centre's work on welding fume. In addition, out of this fundamental work on welding fume, the Centre's "Phoenix" technology was born during the year. This has led to the formation, in partnership with CSIRO, of the company "JoinTechnology Pty Ltd" whose charter it is to commercialise the patented intellectual property known as the "Phoenix" technology.

Industry Benefits

Sub-Program	$M
Pipeline	136-244
Joining Equipment	5
Power Generation	70
Mining	10
Building/Construction	180
OH&S	100
	>500

A summary of each of the Centre's R&D sub-programs follows. Overall, total milestone achievement for all projects throughout the year was at an all-time, high figure of 79%: this measure corresponds to the extent to which milestones planned at the beginning of 2001/2 have been achieved to schedule during the year. This figure corresponds closely with a recently-conducted review of major milestones nominated in the Centre's Commonwealth Agreement, for which an achievement rate (against planned milestones) was 77%. Of those 23 milestones identified in the Commonwealth Agreement for completion in the first two years of operation, 17 (74%) have been completed in full. In addition, three further milestones specified for years 3-5 have been completed early.

Pipeline Research Sub-Program

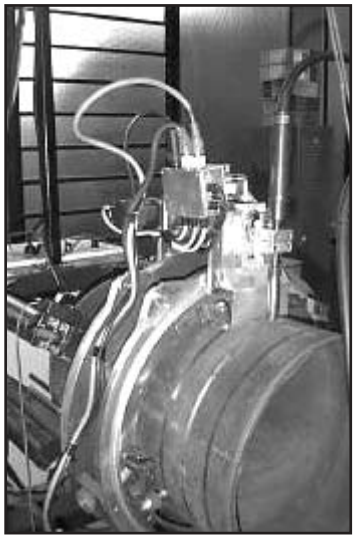
The Pipeline Technology sub-program addresses key improvements impacting the construction, operational efficiency and safety of Australian gas pipelines. The project portfolio is co-funded by industry sponsors (currently numbering 15 different companies) and, apart from two commercial-in-confidence projects, is coordinated by a Pipeline Program Management Committee (PMC) comprising sponsors, researchers, WTIA and APIA and chaired by industry consultant and nominee, Mr Max Kimber.

This PMC has welcomed several overseas visitors during the year, a factor which has led to the prospect of closer interaction between researchers within the CRC-WS's Pipeline sub-program and the Pipeline Research Council International (PRCI) in the USA and the European Pipeline Research Group (EPRG). Such international interest in our pipeline research has culminated in a tripartite technology agreement between APIA, EPRG and PRCI and the prospect of the sale of the CRC-WS's pipeline research reports for the period 1999-2000 to a pipeline company in North America. This increasingly global recognition of the CRC-WS's pipeline research is likely to continue, given the significant technical developments within the Centre's pipeline suite of projects during 2001/2.

Pipeline Construction

An emphasis on reducing the cost of pipeline construction has continued during 2001/2. A computer model of the construction process has been developed during the year for one pipeline company to provide a predictive capability on construction time and costs given a variety of input parameters such as crewing, materials supply to site, terrain, equipment availability, trenching, welding, NDT and pipe size. This software is now at the beta-testing stage of development and will be demonstrated to construction personnel early in 2002/3.

Welding rate and quality continue to represent an important factor in construction and emphasis has therefore been placed on the mechanisation, quality and stability of pipeline girth welding. A laboratory, mechanical girth welding system has been developed which now provides the potential for procedure development for field application. The system was demonstrated to delegates from the International Pipeline Construction Conference (Wollongong, March 2002) and a report, comparing overseas systems for the eventual adoption of mechanised girth welding in Australia, has been issued for comment by the Sponsors.



Laboratory Automated Girth Welding Equipment

A study of welding arc stability in the presence of magnetic fields has been undertaken for two Core Participant companies during the year: It is hoped that a better understanding of the influence of pipe magnetism, the local earth's magnetic field and welding process and procedures on arc stability will smooth the eventual introduction of mechanised welding processes in the future and clarify specification requirements.

Research into factors affecting hot cracking in pipeline girth welds has also been conducted during the year. Such cracking has been shown, in previous CRC-WS pipeline research, to provide potential preferential sites for hydrogen-assisted cold cracking (HACC). The research, which is now complete, has provided recommendations on welding speed and heat input limits to avoid hot cracking and emphasised significantly less sensitivity to chemical composition of the weld metal within the range studied.

Experimental Set Up for simulating Arc Blow in GMAW

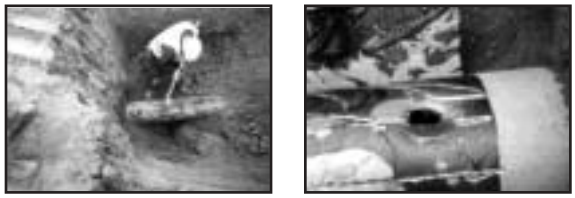
In order to further clarify defect acceptance limits and workmanship standards for pipeline girth welds, testing and evaluation has continued on X70 and X80 pipe grades and relevant welding consumables. The outcomes of the research have, in part, been incorporated into the recently-revised Standard AS2885.

The final stage of pipeline construction is an hydrostatic test applied to each section of the pipeline. This is an "over pressure" test at higher pressure than subsequent normal operation and thus provides assurance of future integrity for the pipeline. This important part of the construction process has been studied and a computer model developed to assist in the conduct and interpretation of the hydrostatic test. The overall model combines a multiple pipe and a single pipe plasticity model and calculates the plastic strains and pressure/volume plot for the entire pipeline. The software has been the subject of significant validation tests (including an instrumented hydrostatic test conducted to failure) and is soon to undergo beta testing.

The team after successfully bursting the gas pipe. From L to R: Phil Hale (ANSTO), Tim Nicholls (ANSTO), Sam Humphries (ANSTO), Graeme Gentles (Agility) and Michael Law (ANSTO).

PIPELINE THROUGH-LIFE INTEGRITY

Several of the pipeline projects, which are collaboratively sponsored by industry, relate to the through-life integrity of pipelines. Both the projects on pipeline awareness and pipeline resistance to external interference have recently been completed and final project reports and/or theses are being circulated for comment. Both projects are likely to result in changes to existing pipeline codes of practice, both in terms of warning signage (advising of a nearby pipeline) and advice concerning the ability of various plant and machinery to damage operational, gas pipelines.



Inspection of pipeline puncture and close-up of damaged area.

The corrosion protection of pipeline girth welds is usually achieved, in part, by polyethylene tapes wrapped around the pipes. Research is being devoted to improving the adherence of these field joint coatings since they have been observed, over time, to disbond and move relative to the weld location.

A further factor influencing on-going pipeline performance is the observation, in certain pipelines and geographical areas, of sulphur deposition usually in areas of significant pressure change.

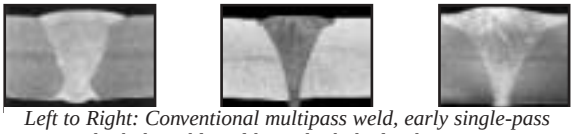
The phenomenon can impede gas flow and lead to safety concerns. An extensive literature survey of the phenomenon is continuing. A further important part of the study is to liaise with operators (both within Australia and overseas) to establish the extent of the elemental sulphur problem (i.e. where it does and, equally importantly, where it does not occur) and obtain samples.

Finally, this summary would not be complete without noting that the CRC-WS's software package, "Hot Tap", has recently gone on sale. The package assists in the nomination of safe welding practices and welding heat input limits (upper and lower bounds) for welding onto "live", gas-containing, thin-walled pipelines. The package was finalised during the year and calculates, for given pipe dimensions, pipe chemistry and gas flows, the maximum heat input in order to avoid "burnthrough" and the minimum heat input advocated to avoid "cold cracking" (HACC) of the weld

JOINING EQUIPMENT & CONSUMABLES SUB-PROGRAM

The key elements of the Centre's Joining Equipment and Consumables sub-program are welding process innovation, the technology of welding consumables and real-time weld quality monitoring. In the welding process arena, the CRC is a joint signatory to two patents, one relating to the "Optarc" power source system, the other to "key hole" welding. In the case of the latter, licence fees for 2001 of $58k were reinvested in further development of the technology. In the case of weld quality monitoring, the potential use of this technology for detecting defects during welding has recently been reflected for the first time in AS2885, the pipeline standard.

During 2001/2, the further development of the Optarc technology has centred on the duplication of the laboratory system and its demonstration at Thermodyne (USA) and the development of a strategy for potential commercialisation. The technology has also been applied to the welding of coated steel, where Optarc has been shown to result in significant quality advantages. In the case of keyhole welding, the Centre has reinvested earlier licence revenues into the further development of the technology: fundamental aspects of keyhole stability are being researched with a particular focus on out-of-position welding.



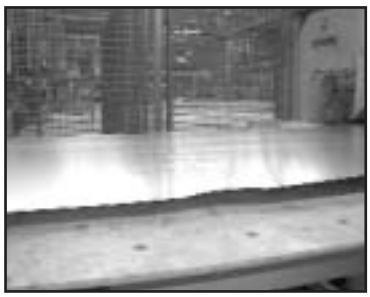
Left to Right: Conventional multipass weld, early single-pass keyhole weld, and latest keyhole development (note improved back-face geometry).

Research to develop improved welding wires has continued during the year. Emphasis has been placed on the manufacturing processes to improve costs, feedability, weld metal hydrogen content and low temperature toughness. During the year, trial batches of a new wire were subjected to market evaluation and a new flux formulation was developed for a flux cored welding wire.

Real Time Monitoring of the welding process offers the potential to reduce weld defects and their associated cost by permitting on-line process control. The potential for reducing or eliminating the cost of and reliance on post-weld non-destructive testing represents a significant potential cost saving for industry. Accordingly, monitoring of the welding process to identify "faults" in real time is a key focus of the Centre's research portfolio.

The Tin Mill Welder showing the welding wheels.

Work during 2001/2 has been directed towards two applications within BHP Steel: both relate to the crucial integrity of welds made to join together coils of strip at the entry point to continuous processing, steel mills. Failure of such welds almost inevitably leads to a "cobble" and production delays in the downstream mill. Innovation directed at BHP's Tin Mill is showing particular promise.



A typical high quality Tin Mill weld

POWER GENERATION & PETROCHEMICAL INDUSTRY SUB-PROGRAM

The Centre's "Power Generation" suite of research projects was launched in July 2001, sponsored for three (3) years by ten (10) individual power stations from the Northern Territory, Queensland, NSW and Victoria. As for the above-mentioned Pipeline Research Sub-Program, this "PowerGen" sub-program is coordinated through a Program Management Committee (PMC) which is chaired by an industry nominee (in this case, Mr Alan Beveridge from Loy Yang Power), is composed of CRC-WS researchers and sponsor representatives and meets quarterly to review progress and to guide future project emphasis. Presentations made at the PMC and minutes of these meetings are recorded on CD and distributed to sponsors. Project reports are distributed similarly.

The following progress has been made in this, the first of three years of sponsorship:

STRUCTURAL INTEGRITY

High energy piping systems, operating at high temperature and pressure, are subject to creep damage especially where undesigned applied loads cause high stresses in welded joints at rigid connections. The rate of creep damage, sometimes in combination with fatigue cracking, may be accelerated with changes in plant operating routines.

Consequences of a catastrophic pipe failure are severe. Major failures have resulted in deaths in USA power stations and there has been a major shutdown in Australia. Piping replacement costs may run to $10,000,000 or more. Focused and therefore cost effective plant inspection and monitoring procedures are being developed to optimise knowledge of plant condition.

The aim of the project is to develop comprehensive asset management guidelines aimed at giving plant owners a high level of confidence in the safety, availability and remaining life of their piping systems.

A key focus of the sub-program is an integrated study of steam piping system asset management techniques to determine the effectiveness of present day, power station practices. The study combines advanced stress analysis techniques, materials testing of service aged and life-expired materials from operating plant and continuous monitoring of pipe strains at critical locations. To date, in-situ assessment of piping systems at two individual power stations has been carried out and materials characterisation of header materials from a pipe failure in Ireland is well underway.

NEW MAINTENANCE STRATEGIES

Mr Bob Midgley of Pacific Power standing beneath the high energy system pipes at Eraring Power Station, NSW.

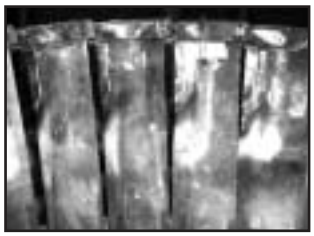
Creep is the main degradation mechanism of piping systems and components operating at elevated temperature, and determines the safe useable life of power generation plants and also petrochemical plant components. The creep damage occurs at the highest stress areas and is often associated with welds. Current repair practice involves complete replacement of headers and piping systems which is very expensive and the lead time for manufacturing replacement components can result in extensive down times. A good practical guideline document detailing the amount of creep damage at which safe weld repair can be performed does not exist. As a result, extensive replacement of components is performed even though the components may still have many years of safe operating life left. A comprehensive guideline document based on current world's best practice is currently being developed for the Australian industry.

Cavitation and erosion are also key materials damage mechanisms in power plants. They occur, for example, on the turbine runners of hydro turbine plant. This mechanism leads to rapid loss of material once initiated, affects performance and efficiency and can lead to imbalance conditions increasing the risk of vibration and fatigue damage of the runner and, if left unattended, could lead to catastrophic failure and/or loss of generation capability. Weld repair is a recognised method of replacing lost material in these eroded and cavitated areas. Currently, any welding would be done manually with the extreme safety risks of working in confined spaces with very difficult access. An automated robotic system for replacement of lost material capable of doing preparation, welding and surface profiling after repair has the potential to greatly enhance the quality of such repairs, making them more reliable, and would eliminate the safety hazards associated with manual repair techniques. Such a system is currently under development.

Rapid erosion of turbine blade edges results when condensate from LP (low pressure) steam impinges onto the blades in the region of the arch cover bands. Non-uniform metal loss then impacts on the balance of the rotor, so that excessive vibration may determine that a costly unscheduled shutdown may occur. In a worst case scenario, the brazed edge protection strips may deteriorate to the stage where one or more strips are dislodged, causing catastrophic damage inside the turbine. The potential exists to use laser surfacing to combat erosion and extend life.

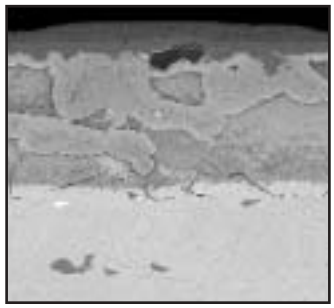
Turbine Blade Set

Replacement of high twist blades is very expensive, and therefore emphasis is placed on techniques for extending the safe life of these blades by the use of leading edge protection strips which are brazed onto the forged blade. This maintenance operation requires the blades to be dismantled from the rotor, and a non-generation period of at least three weeks is unavoidable. The opportunity exists for the in-situ application of laser surfacing of the leading edge with an erosion resistant layer without the need for dismantling of the rotor, potentially taking two weeks out of each blade maintenance shutdown. This research project has a high potential to make substantial savings in power generation operating costs.



Worn Turbine Blade profile

Many turbine valve spindles are retired before their expected service life is achieved due to problems caused by surface coatings. A major problem in the electricity industry is oxidation of spindles surfaced with carbo-nitrided coatings. This oxidation, often referred to as "blue blush", causes an increase in spindle diameter which eventually closes clearances, potentially jamming the valve with serious station consequences. This research aims to extend spindle life and reduce maintenance by seeking an alternative coating to carbo-nitriding, which may be applied locally to ex-service spindles.



Microstructure of Turbine valve spindles

POST WELD HEAT TREATMENT (PWHT)

Post Weld Heat Treatment (PWHT) is the most widely accepted form of stress relieving upon completion of welding construction or repair. PWHT or thermal stress relief works on the principle of the temperature being raised until the yield stress has fallen to a value where the residual stresses can no longer be supported, thus localised plastic deformation and some creep occurs to reduce residual stresses.

The disadvantages of PWHT listed below have led to the current interest in PWHT and the possibility of optimising or eliminating PWHT or even considering different means of stress relief:

- Cost and delay of PWHT
- Scaling may result
- PWHT process can become complicated and time consuming
- Effect on mechanical properties (YS and TS decrease as the Holloman Parameter increases).

Australian standards for pressure equipment make PWHT mandatory for listed materials, thicknesses and conditions. These requirements have been carried over from early standards based on old steels and NDT. A clearer understanding of PWHT is thus required, especially in relation to modern steels and improved methods of design and construction.

MINING & MINERALS PROCESSING SUB-PROGRAM

Australia is a large consumer of wear resistant components. The ability to produce verified superior coating materials will be of significant benefit to Australian industry. The development of these consumables will also provide opportunities for Australian miners to reduce costs and for Australian manufacturers to export into the large markets overseas. In addition, the development of a significant surface engineering facility within the CRC will provide a range of services to other CRC projects (e.g. in the area of power generation).
Corrosion and/or erosion resistant surfaces on components enhance the performance and extend the life of these components. These surfaces can be provided by any of a number of surfacing processes – e.g. weld overlaying, spray coating and laser cladding. However, the microstructure of these surface layers and the effect of that microstructure/composition on component performance are not fully understood despite the fact that the rate of wear depends on microstructure. For example, the presence of primary chromium iron carbide reduces the rate of abrasive wear but the presence of complex regular chromium iron carbide reduces impact resistance due to the interconnectivity of the carbide. This project is currently characterising the microstructures of commonly used cladding materials and processes. This will allow for the development of surfacing materials with enhanced wear resistance. Baseline wear data for standard wear resistant surfaces is being collected and compared with data generated for the modified surface layers.

Front-end loader utilised in the Alumina Industry.

It is hoped that the scope of this sub-program will expand during 2002/3 as a result of current discussions with the Alumina industry.

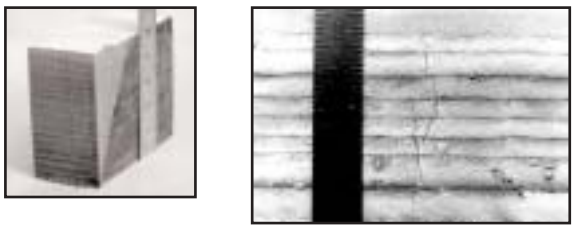
BUILDING & CONSTRUCTION SUB-PROGRAM

The following sub-program is the CRC-WS's largest and comprises research emphases on improvement to the cost-effectiveness, quality and integrity of steel and light alloy structures. The research projects also include assessments of non-welded methods of construction in the form of fastenings.

WELD QUALITY – CONSTRUCTION

Work is well advanced on an expert system to assist the user to readily develop welding procedures which comply with the major Australian Standards. A prototype of the user interface has been developed and a prototype software package will be completed by December 2002, incorporating an ability to establish parameters such as preheat, material, joint geometry, etc consistent with current best practice and AS1554, 2885 and 3992.

Several other projects, under this overall banner, are seeking to provide extensions to current best practice and current understanding in the area of weld quality. One such project relates to the occurrence of sub-surface and sometimes surface-breaking transverse cracks in multipass welds of structural steel plate in thickness of around 20mm and greater.



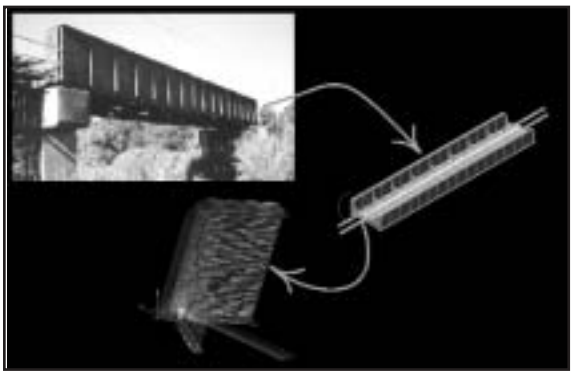
Examples of Hydrogen Transverse Cracking in Weld Metal

This type of cracking is of concern in terms of resistance to brittle fracture under severe service conditions. The cracks are typically located between the capping passes and the middle layer and the density increases with reduced interpass temperatures and increased weld metal hydrogen. These cracks are referred to as hydrogen induced transverse cracks which are perpendicular to the welding direction in a plane either at 90º or approximately 45º to the surface of the welded plate. The study is focussing on flux cored arc welds for which transverse cracking has recently been successfully reproduced in the laboratory.

Zinc-coated steels are also widely used in construction, mainly in thinner, lighter construction. Emphasis by the Centre has recently been placed on the weldability of such steels, particularly in relation to surface quality, oxidation and fume suppression during welding. Innovative techniques have been proposed and trialled with encouraging results, particularly for the flux cored welding process. Improved procedures are being documented and communicated to industry as they emerge.

STRUCTURAL DESIGN AND INTEGRITY

Emphasis in the area of structural design and integrity is being devoted to steel bridges, ships, offshore structures and buildings. The assessment of structural reliability is fundamental to the infrastructure asset management program of the State Rail Authorities. Each year, hundreds of millions of dollars are devoted to construction, maintenance, repair and replacement of load-bearing railway structures. This research project has advanced the state of engineering practice in this area through development and implementation of effective analysis concepts, tools and methodologies to guide decision-making for fatigue damage, structural integrity and remaining life of steel railway bridges. Successful completion of this project will lead to transfer of the same techniques to fatigue assessment of welded fabrications of any type.



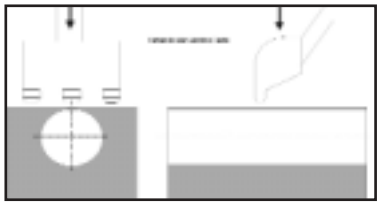
Picture showing the link between a railway bridge being analysed and the analytical approach.

The project aims are to be met through collaboration among scientists and engineers from research organisations together with engineering managers from railway organisations. The basic approach to structural integrity assessment is based on a three-stage methodology. This incorporates bridge structural design, loading history, component stresses and material properties and conditions. Assessment procedures make use of varying degrees of detail from the least detailed, most conservative, lowest cost level at Stage 1 to Stage 2 with more detailed, increased cost, less conservative assessment, to Stage 3 which includes the most detailed inspections and analyses, with the least conservatism. This general framework, which is accepted in the electric power industry and in aerospace and military programs, will provide railway engineering managers with a rational scheme to organise and deploy resources for infrastructure maintenance, repair and replacement. These aspects have been applied in detail to one particular railway bridge as an illustration of the practical application of the concepts which can impact structural integrity, safety and through-life costs.

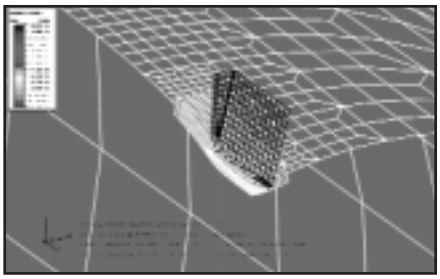
These key impacts are particularly beneficial when considered at the early design stage of structures when, for example, through-life cost considerations can be considered before structural designs are finalised.

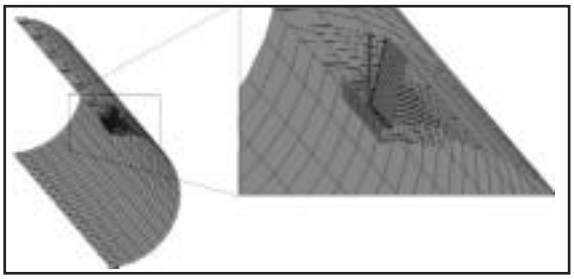
In the case of design of marine structures, the Centre has continued its project to demonstrate the fabricability and benefits of high strength steel in Defence vessel applications. Here, higher strength steels such as the X80 high strength low alloy (HSLA) steel developed originally for pipelines, offers the benefits of high weldability and toughness and the potential for lighter, faster vessels achieved through down-gauging. While the prime objective of this project, namely to install a demonstration X80 panel into an ANZAC frigate, was not achieved due to time and regulatory constraints, the project team are now focussing on a demonstration of the steel's advantages and capabilities in an existing vessel.

Offshore structures for the oil and gas industry are of key importance to Australia as a vehicle for both domestic energy needs and export. The Centre's research project in this area seeks to assist the Australian offshore oil and gas construction industry to take advantage of applied research and development for the customisation of solutions utilised in other parts of the world for Australian conditions, and the development of new solutions where no existing solution is available. Development of modular construction techniques for offshore facilities will enable Australian construction industry to be able to bid for the supply of offshore structures that have traditionally been won by Asian competitors. Development of damage and failure models will allow safe and efficient structures to be developed. Furthermore, the development of structural reliability design guidelines will enable more efficient facilities to be developed which meet the safety requirements.



Dent Testing Rig





Finite Element models for dent analysis

The research has therefore required the development of a detailed understanding of local metocean conditions, evaluation of structural responses to these imposed conditions, the derivation of structural design and construction options and a survey of the capabilities of local fabricators. All these factors have been advanced significantly during the year.

The Centre is also investing significantly in the design development and evaluation of land-based structures. This includes innovative work on roof and wall systems with concealed fasteners for which little Australian research has recently been conducted.

It is therefore essential that research is performed if we are to keep up with world trends. In particular, concealed fixed systems are 80% of the market in the USA and Europe. In Australia, they are about 20%. This should not lead to complacency as we may be subjected to imported product which we do not understand. More importantly, Australia has the opportunity to export in this area provided that R&D is performed to develop, support and substantiate market advantage. The novelty of the work lies in investigating new Australian systems using USA Test Methodology and developing new systems for use in Australia and for export.

A significant series of vacuum rig tests have been conducted which simulate wind and primary loading and recommendations/conclusions are in the process of being documented.

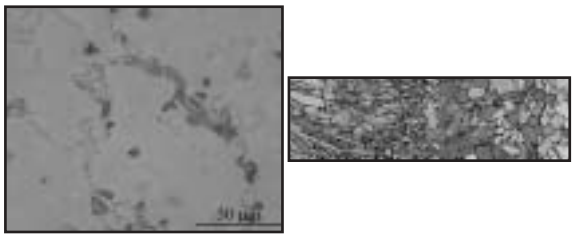
Mike Bambach in front of the test rig at the University of Sydney

CRC work also has focussed on portal frame development utilising single point, self-drilling, self-tapping fasteners (Tek screws). The project is novel in that it addresses a problem with single point, self-drilling, self-tapping screws when drilled into rectangular hollow sections (RHS). Research has therefore been sponsored by industry to ascertain the strength and ductility of such fasteners, particularly when installed in high strength RHS and subjected to multi-axial stress states. A literature review has been conducted on this issue and laboratory test rigs are under construction.

A related project on the welding of rectangular hollow section (RHS) members of equal width is also being progressed. These connections have been included in past editions of AS/NZS1554.1 Welding of Steel Structures, but have been excluded from the current revision. The exclusion is on the basis that the rounded corners of cold-formed rectangular sections will reduce the strength of the welded connection. All sections in Australia are produced by cold forming. This project is aimed at establishing prequalified weld preparations for such connections, thereby obviating the need to conduct expensive weld prequalification tests for each application. The project has been successfully completed and the results will now form part of a revised Australian Standard.

LIGHT ALLOY CONSTRUCTION

This area of research has been prompted by wide-ranging discussions with potential customers (e.g. fast ship builders, Department of Defence, etc) and associated researchers (such as members of the CAST CRC). The R&D has capitalised, in part on previous CRC-WS projects in Friction Stir Welding (FSW) of Al alloys and the fact that little previous work appears to have been devoted to the solidification of Mg alloys.



A picture of the microstructure of magnesium (left), and one of an EBSD scan of a TIG weld in magnesium (parent metal of the RHS and weld metal on the LHS). This latter picture shows colour codes discriminating grain orientation and so shows the morphology of the grains and their crystallographic orientation.

Emphasis has therefore been given to a literature survey and fundamental study of the welding and solidification of Mg alloys. Work is well advanced on TIG and laser welding of Mg alloys, and both thick and thin (wrought and cast) sections have been studied. In one encouraging experiment, an aluminium and a magnesium alloy were successfully joined by FSW although the mechanical properties of the joint were less than satisfactory.

The principal industrial application of this and parallel CRC-WS work is in the area of aircraft repair and, in the case of Mg alloys, automotive applications.

Structural degradation of high strength aluminium aircraft alloys represents a significant through-life maintenance cost for the military and civilian aircraft fleets in Australia, and indeed worldwide. Loss of aircraft availability during major refurbishments is seen as an additional problem and further compounds the overall cost. Repair and rebuild of components containing corrosion, fatigue cracking and wear damage, including corroded and/or cracked holes, would mean a significant saving in through life-costs by extending their service lives. Friction technology, including the newly emerging technology of FSW, is seen as probably the most promising approach to reducing maintenance costs through increased component lifetime and aircraft availability, particularly for the RAAF. A large proportion of structural components in the current, ageing RAAF aircraft fleet is made of high strength aluminium alloys (7xxx series), and they deteriorate slowly during service due to cracking and/or corrosion related damage. The current practice of dealing with corroded areas is to remove them by grind-out – up to ~10% of section thickness, depending on the extent of damage. This operation can be very time consuming and the components' life and aircraft availability may also be reduced in the process. The aim of this project is to evaluate the potential of the friction processing technique for the repair and rebuild of aluminium alloy components containing stress corrosion or fatigue cracking or corrosion grind-out and cracked and/or corroded holes. In the first phase of the project, the work has involved use of materials of aerospace grade aluminium alloys (e.g. AA7075, AA7010) with corrosion damage and cracking introduced. Initial weld repairs have been made on samples in the laboratory and these are now being subjected to testing and evaluation.

HEALTH AND SAFETY SUB-PROGRAM

The Centre's OH&S work, primarily on Welding Fume, has continued during the year. Developments in this area over the last twelve months can be usefully summarised as follows:

- The "Phoenix" technology, which had its origins in the project area of fume reduction technology, has been the subject of several provisional patents during the year and the rationale for the formation of the arms-length company, JoinTechnology Pty Ltd.
- Attempts to obtain external part-funding for a medical/welding project on the effects of welding fume on lung function were unsuccessful. This project was to have involved Monash University and Austin Hospital's Department of Epidemiology and
- The Centre commenced an additional, fundamental project in the area of the chemical analysis of welding fume.

This latter project encapsulates three threads concerned with characterising welding fume composition at source, modelling how it propagates and measuring the quantity of fume in the welder's breathing zone. Overall the project is aimed at reducing the quantity and, potentially, toxicity of fume to which welders are exposed. This project examines three ways in which the quantity of harmful fume reaching the welder's breathing zone can be minimised. The first of these uses a non-intrusive analysis system in the form of a tunable laser to determine the atoms and molecules present in a particular location relative to the welding arc. This information can be used to build up a composition map for the selected atoms/molecules at varying distances from the arc and therefore study the dynamic and equilibrium chemistry of the fume evolved. The potential of introducing material into the arc which will react with the fume during the dynamic phase of its evolution to form less insidious compounds will be investigated. The second project area aims to develop a sensor for breathing zone fume measurement in arc welding situations. The third project area (which is now almost complete) applied measurement and modelling techniques to fume plume propagation and used the results of these studies to assist in the control of breathing zone exposure.

Education Program

The Education Program of the Centre encompasses both the delivery of a distance education programme and the support and education of research students employed on projects which are either wholly or part funded by the CRC for Welded Structures. With the Welding Engineer course involving both Graduate Diploma and Masters courses and the research strategy also involving undergraduate student projects, the Education Program of the CRC-WS ranges from Diploma level through to Masters level and beyond. This overall strategy enables research to be resourced for relatively short to long term initiatives with research fellows and PhD students able to focus on the longer term strategic goals of the Centre.

Welding Engineer Course

The Centre's Welding Engineer course has been available since the mid-1990s but, as reported previously, converted wholly to distance delivery mode in February 2000 and, last year, also achieved the unique position of being fully accredited by the International Institute of Welding (IIW) as the only accredited distance education course for international welding engineers in the world. Thus while the course continues to attract modest numbers of students from Australia, the course has been creating interest on a world-wide basis. This accreditation has provided the Centre with a significant opportunity to market the course world-wide and, during 2001/2, the Centre successfully licensed the course to Cranfield University. Cranfield have since recruited a resource to manage this course delivery from the UK and have announced their intention to commence course delivery in late 2002. Licence revenue will flow to the CRC for Welded Structures shortly thereafter. This is the first initiative to flow from the Memorandum of Understanding signed between the Centre and Cranfield University during 2001/2. Under the arrangement, the Centre and Cranfield University will share improvements made by either party to the course and, therefore, provide a long term relationship in the further development of the course and its delivery. The scope of the licence granted to Cranfield provides rights to the course delivery throughout Europe. This new relationship with Cranfield University has been extended to discussions about a research relationship, particularly in the pipeline arena, and discussions and plans are at an advanced stage to launch a joint project also involving the Edison Welding Institute (EWI) during 2002/3.

Discussions have also been held during the year with many international welding bodies with the intention of negotiating a similar arrangement with other countries or continents. These discussions are ongoing at the present time but include interested parties in North America and South East Asia.

It is intended in 2002/3 to offer elements of the summer school course to engineers in the general community to update their skills in aspects such as Non Destructive Testing and Welding Metallurgy. This will provide an opportunity for career engineers to update their skills and dovetail with the distance education students who attend our summer school at the University of Wollongong each year.

Research Students and Research Strategy

As indicated above, the CRC for Welded Structures engages students in research at all points of their career. At the undergraduate level, the Centre assists with undergraduate vocation training both at the Centre and at Core Participants. It also nominates project ideas and industry needs in the formulation of undergraduate fourth year projects. This early involvement at undergraduate level has had some success in attracting undergraduates into research and, in some cases, into R&D associated with the welded structures industry. At the graduate level, the Centre funds or part-funds both Masters and PhD students. A mini-research project and project report are also required as part of the graduate welding engineer course. In addition, the funding of research fellows assists with the strategic and short term initiatives of the Centre, acting mostly as a supervisory capability to postgraduate research students.

Two University of Adelaide students at work in the Laser Laboratory - Karel Meeuwissen (top) and Owen Lucus (bottom)

A major strength of the Centre is the fact that almost 80% of its research projects involve industry participation, either by way of cash or in-kind contributions. This leads to a close relationship between the research students and industry representatives. Invariably, this interaction is on a quarterly basis and is particularly noteworthy in relation to our Pipeline and Power Generation suites of projects where a Program Management Committee meeting is held regularly either at a Research Core Participant or at an industrial site of relevance to the project or sub-program.

RESEARCH STUDENTS

Those research students who were involved with the Centre during 2001/2 are listed in the following table.

STUDENT	UNIVERSITY	START DATE	SUBMIT DATE	STATUS	TYPE OF STUDY	SUPERVISOR NAME	CO-SUPERVISOR NAME	CO-SUPERVISOR AFFIL.	TITLE OF THESIS	FUNDING SOURCE
Ben Daka	Adelaide	Jan-01	Jun-02	Completed	MEngSc	Mr I Brown	—	—	HACC in Welds	Self Funded
Daniel Miller	Adelaide	Dec-01	Dec-02	Continuing	MEngSc	Prof V Linton	Mr I Brown	UoA	FSW on Airframes	Self Funded
Geoffrey Osbourne	Adelaide	Jul-99		Continuing	MEngSc	Mr I Brown	—	—	FSW Process Varied	CRC
Julian Hamedi	Adelaide	Jan-02		Continuing	MEngSc	Prof V Linton	Mr I Brown	UoA	FSW Repair of Airframes	CRC
Leonard Mills	Adelaide	Jul-99		Continuing	MEngSc	Mr I Brown	Prof J Norrish	UoW	Mechanised Girth Welding Control Systems	CRC
Liz Brierley	Adelaide	Jan-02	Jun-03	Continuing	MEngSc	Prof V Linton	—	—	Expert Systems	Self Funded
Rudi Zettler	Adelaide	Jan-00	Dec-02	Continuing	MEngSc	Prof V Linton	—	—	Friction Stir Welding	CRC
Alasdair McLean	Adelaide	Jan-99		Continuing	PhD	Mr I Brown	—	—	Welding of Magnesium	CRC
Alex Dunstone	Adelaide	Jan-00		Continuing	PhD	Dr B Cazzolato	Dr M Painter	UoA	Stress Development of Pipline Girthwelds	CRC
Karel Meeuwissen	Adelaide	Feb-02		Continuing	PhD	Prof V Linton	Dr Z Alwahabi	UoA	Welding fume	UoA
Owen Lucas	Adelaide	Feb-02		Continuing	PhD	Prof V Linton	Dr Z Alwahabi	UoA	Fume	CRC
Vinay Tyagi	Adelaide	Jan-99	Jun-02	Completed	PhD	Mr I Brown	Dr R Kargas	CSIRO	Influence of Alloy Additions on Weld Metal from Gas Shielded Processes	CSIRO
Andrew Stewart	UWA	1998		Continuing	Masters	Prof B Ronalds	P Venton	Duke Energy	Damage and Failure Mechanisms	CRC
David Louer	UWA	2001		Continuing	Masters	Dr M Fakas		—	Requalification of Offshore Platforms	Worley
Kittiphop Chayraksa	UWA	1999	2001	Completed	Masters	Dr M Fakas	—	—	Risk Analysis and Cost Estimation of Decommissioning of Large Jacket Platforms	UWA
Daniel Brooker	UWA	Jun-99	Jun-02	Completed	PhD	Prof B Ronalds	—	—	Investigation of Damage and Failure Mechanisms in Offshore Structures	UWA
David Pack	UWA	Mar-01	Mar-04	Continuing	PhD	Assoc Prof T Edwards	—	—	Formation of Elemental Sulphur in Natural Gas Pipelines & Infrastructure	Privately Funded
Lee O'Neil	UWA	1999		Continuing	PhD	Dr M Fakas	PE Christensen	Kvaerner Oil&Gas	Float-over Deck Installation in Australian Waters	Woodside Energy
Micaela Pilotto	UWA	Oct-01	Oct-03	Continuing	PhD	Prof B Ronalds	Dr G Cole	UWA	Dynamic Response of Braced Monopod Platforms	Postgrad Fee
Suhartodjo Tuty	UWA	Jun-99	Jun-02	Completed	PhD	Prof B Ronalds	Dr M Fakis	UWA	Reliability Assessment of Platforms on the North West Shelf	UWA P/G Award
Ian Roach	Wollongong	2000	Dec 02	Continuing	MCom (Hons)	Prof R Badham	—	—	Pipeline Awareness	CRC
Leone Dunn	Wollongong	1996		Continuing	ME (Hons) Part-time	Prof J Norrish	—	—	Computer Based Agile Control of Fabrication Operations.	Self
Ben King	Wollongong	2002		Continuing	MEng	Prof D Dunne	A/Prof T Chandra	UoW	Post Weld Heat Treatment of CrMo Steel	CRC

Education Program

STUDENT	UNIVERSITY	START DATE	SUBMIT DATE	STATUS	TYPE OF STUDY	SUPERVISOR NAME	CO-SUPERVISOR NAME	CO-SUPERVISOR AFFIL.	TITLE OF THESIS	FUNDING SOURCE
Anthony Falivene	Wollongong	1998		Continuing	MEng (Hons)	Prof D Dunne	Dr M Ferry	UoW	Arc Welding Ti Microalloyed Structural Steels	CRC
Elizabeth Budzakoska	Wollongong	2001		Continuing	MEng (Hons)	Prof D Dunne	A Crocker	ANSTO	High Integrity Pipe	APA-I
Gary So	Wollongong	1999	Aug-02	Continuing	MEng (Hons)	Dr F DeBoer	Prof J Norrish	UoW	Pipeline GMAW Stand-off Control	UoW
Andrew Romanov	Wollongong	2000	2002	Continuing	MEPrac	Prof J Norrish	—	—	Cavitation Resistant Wear Materials for Hydro Turbine Repair	Self
Dragan Marijan	Wollongong	2000	Aug-02	Continuing	MEPrac	Prof J Norrish	—	—	Application of Corrosion Resistant Steels to Rail Wagons	Self
Eddy Derwort	Wollongong	1999		Continuing	MEPrac	Prof J Norrish	—	—	The Refurbishment of Crawler Shoes using Robotic Welding	Self
Peter McDonald	Wollongong	1998	Jun-02	Completed	MEPrac	Prof J Norrish	Max Conyngham	CRC	Computer Network Data Base - Welding Procedures/Qualifications	Transfield
Adrian Collins	Wollongong	2000	Jul-02	Continuing	MSc	Dr L Dunn	Prof J Norrish	UoW	Distributed Quality Monitoring for Automated GMAW of Pipeline	APA-I
Mile Purdevski	Wollongong	1998	Dec-01	Completed	MSc	Prof J Norrish	Dr F DeBoer	UoW	Defect Monitoring in Pipe Welds	CRC
Aleksandar Alimpijevic	Wollongong	2000	Dec 02	Continuing	MSc (Hons)	Prof J Norrish	Dr P Di Pietro	UoW	On line Monitoring System for Pipeline Girth Welding	CRC
Alex Nicholson	Wollongong	2002		Continuing	PhD	Dr P Di Pietro	I Wright	Eraring Energy	Hydro Turbine Repair	CRC
Ben Lake	Wollongong	Mar-02		Continuing	PhD	Prof M West	—	—	Fatigue Loading of Railway Bridges	UoW/CRC
Bradley Glass	Wollongong	1999		Continuing	PhD	Prof M West	—	—	Structural Loads and Dynamics Issues in Fatigue of Steel Railway Bridges	UoW/CRC
Dominic Cuiuri	Wollongong	1996	Sep-01	Completed	PhD	Prof C Cook	Prof J Norrish	UoW	Optimised Arc Welding Systems	CRC
Gary Dean	Wollongong	1999	Dec 02	Continuing	PhD	Prof J Norrish/ Prof C Cook	R Wiseman	Therma-dyne	Optimised GMAW	CRC
Geoff Slater	Wollongong	2000		Continuing	PhD	Prof J Norrish	A/Prof P Cooper	UoW	Welding Fume Distribution	APA-I
Jeffrey Gao Jin	Wollongong	2001		Continuing	PhD	Prof G Wallace	Prof J Norrish	UoW	Electronic Nose for Ozone Detection	APA-I
Laurie Jarvis	Wollongong	1995	Jun-02	Completed	PhD	Prof M West	Dr N Ahmed	CSIRO	Keyhole Formation in Welding of Stainless Steels	Self
Liang Chen	Wollongong	1995	Dec-01	Completed	PhD	Prof D Dunne	Dr L Davidson	DSTO	Transverse Hydrogen Assisted Cold Cracking in High Strength Structural Steels	CRC
Michael Siminski	Wollongong	1998	Dec 02	Continuing	PhD	Dr F DeBoer	Prof J Norrish	UoW	Rapid Prototyping Programming	CRC
Mike Pitrun	Wollongong	2000	Dec 02	Continuing	PhD	Prof D Dunne	Dr D Nolan	UoW	Weld Metal Cracking - FCAW	CRC/UoW
Peter Sorrenson	Wollongong	1999		Continuing	PhD	Prof M West	—	—	Fatigue Damage and Fracture of Steel Railway Bridges	UoW/CRC
Shao Hua Zhou	Wollongong	1997		Continuing	PhD	Prof J Norrish/ Dr Z Chen	A Forbes	WTIA/ API-A	Fume Formation mechanism	APA-I
Yan Wan Chen	Wollongong	1997		Continuing	PhD	Prof D Dunne	Prof J Norrish	UoW	Weldability of Cold Rolled Sheet Steels	APA-I
Yilan Luo	Wollongong	1997		Continuing	PhD	Dr Z Chen	A Croker	ANSTO	Life Estimate of Welded Pressure Equipment Operating at Elevated Temperature	CRC
Zoran Sterjovski	Wollongong	2000		Continuing	PhD	Prof D Dunne	TBA	WTIA	Post Weld Heat Treatment Pressure Vessels	APA-I

Utilisation & Application of the Research, Commercialisation, Links with Users

Strategies for Technology Transfer

The Research and Development portfolio of the CRC for Welded Structures comprises projects which originate from one of three sources:

1) a project proposal emanating from a researcher;

2) an industry need, as articulated by a single sponsor; and

3) an industry need, as articulated by a group of sponsors, usually from a particular industry sector.

With approximately 80% of the Centre's R&D funds directed at single or group-sponsored projects and with projects in the first category ultimately seeking to attract a sponsor in the future, it is inevitable that the Centre relies heavily on its extensive industry network, for the articulation of research needs, for cash and/or in-kind support and the commercialisation of technology.

This network is largely facilitated through the two Industry Association Participants in the Centre. In the case of WTIA, Corporate membership exceeds 300 with individual memberships approaching 1,400. Over 65% of WTIA's Corporate members are SMEs. APIA has over 200 Corporate members. Taking due regard of common membership of APIA and WTIA, the Centre has access to the views, research needs and technology transfer requirements of over 450 companies, at least half of whom are SMEs.

Networking Initiatives

Interaction with these companies is facilitated by formal meetings organised within the framework of WTIA and APIA operations. Specifically, WTIA organises Technical Panels which range in content from Pressure Vessels (Panel 1), Welding Metallurgy of Steels (Panel 2), Aluminium (Panel 3), Lasers (Panel 4), Welded Structures (Panel 6), Pipelines (Panel 7), Reclamation (Panel 8), Occupational Health, Safety and Environment (Panel 9) and the Physics of Welding (Panel 14). Appropriate Centre projects are discussed and, in several cases, sponsored by industry members serving on these Panels. Equally APIA has a number of committees with member representatives and the Centre is similarly represented on APIA's Research and Standards Committee and its Education Committee.

Demonstration of Robotic Hot Tapping to pipeline industry representatives (July 2001)

These forums serve to raise industry issues, receive Centre project proposals, review project status and facilitate and encourage the implementation of research outcomes. During the year, there were 29 meetings of WTIA Technical Panels and CRC-WS Program Management Committees, with 210 attendances by industry representatives and 109 by researchers, underlining the significance of the level of technical interchange between industry and the Centre's research staff.

The CRC-WS Core Participants also form an integral part of the OzWeld Technology Support Centres Network established by the WTIA in early 1998 and which now links 29 local centres including Core Participants, and 10 overseas centres. The Network has 9 State Technology Managers based in five mainland states and the Northern Territory, with the Victorian-based Manager responsible also for Tasmania and the NSW-based Manager responsible for the ACT. The CRC-WS provides a resource to support this Network through its linkages of scientific and technological expertise, and in turn receives feedback from industry on its needs and capabilities. Through this network, it is possible to identify opportunities for industrially beneficial research which will attract industry to provide funding to the Centre.

An initiative which supports this goal is the establishment of SMART (Save Money And Re-engineer with Technology) industry groups which have been created by WTIA in various industry sectors. These closed forums facilitate the sharing of issues. They are important vehicles for the feedback of industry needs, and gathering potential project support for the CRC-WS.

The year also saw the commencement of the CRC-WS's Power Generation sub-program, sponsored for three years by ten (10) Power Stations from the Northern Territory, Queensland, NSW and Victoria. The sub-program includes six agreed projects which were selected by the sponsor group, are overseen by nominated industrial advisers and reviewed quarterly by the Sponsor Group. This has been a major initiative for the year and follows the successful template developed within the Pipeline sub-program, which was sponsored by fourteen companies in 2001/2.

Ongoing Technology Transfer

Outputs from the CRC Research Program are frequently published in the Australasian Welding Journal and refereed Research Supplement to the Journal as well as in the Proceedings of various Technology Forums. All Proceedings and the contents of the Australasian Welding Journal are indexed in the online bibliographic database Weldasearch, maintained by TWI in the UK. The research activities of the CRC are also publicised through the Internet website operated by the CRC (www.crcws.com.au), which also displays the latest editions of the CRC newsletter 'Joining Forces' and links directly to Participant websites. The WTIA website (www.wtia.com.au) also links to the CRC-WS site, as well as listing CRC-WS publications and researcher contact details.

Technology Forums and exhibitions, detailed elsewhere in this report, provide further avenues for technology transfer.


JOINING FORCES

The international linkages provided by the CRC, especially with Core Participant TWI in the UK, the International Institute of Welding of which WTIA is the Australian representative body, the Edison Welding Institute (USA), the European Pipelines Research Group (EPRG) and the Pipeline Research Council International (PRCI), are vital to meeting the goals of Australian industry. Part of the role of the Centre is to actively link into the vast resources of overseas organisations, and to facilitate access to relevant technologies by Australian industry, particularly SMEs which may not otherwise have this contact. This role is significantly facilitated by the WTIA's OzWeld Technology Support Centres Network.

Additional international linkages were established during the year with the CRC-WS entering into Memoranda of Understanding with Osaka (Japan), Cranfield (UK) and Chosun (Korea) Universities.

UTILISATION & APPLICATION OF RESEARCH

Around mid-year, the CRC for Welded Structures formed a spin-off company, JoinTechnology Pty Ltd. (The company name encapsulates the fact that the company will be involved in commercialising both "jointly owned" and a "materials joining" technology). The technology being progressed to commercialisation is the so-called "Phoenix" technology, which is jointly owned by the CRC-WS and CSIRO. JoinTechnology has since successfully applied for a $100k COMET grant which is now being utilised to develop a business plan, an intellectual property strategy and legal framework for the fledgling company.

JoinTechnology Pty Ltd

The Phoenix technology has been the subject of three provisional patents during the year and has been demonstrated to potential end users. Industry trials of the technology are being progressed at the time of writing this Annual Report.

Tom Gordon (left) and Bernie Bednarz at the world-first demonstration of the Phoenix Technology, March 2002

The Centre has received significant licence revenue for the TIG keyhole welding technology during the year. This cash income was more than fully reinvested in extending the technology to out-of-position welding with the aim of extending the revenue stream in the years ahead. The Centre also completed and commenced sales of its "Hot Tap" software, an Expert Technology Tool which advises on welding heat input ranges appropriate to the task of welding attachments or branch connections onto pressurised gas pipelines.

During the year, the CRC-WS also communicated several of its research outcomes to various Standards Committees for inclusion (or potential inclusion) in revised Standards. This "public good" aspect of the Centre's operations saw the inclusion of new strategies for defect acceptance levels, weld monitoring and other research results embodied in the new version of AS 2885, the pipeline Standard. Also, outcomes from the Centre's work on standard welding procedures for rectangular hollow sections will be incorporated in a future revision of the steel structures Standard.

The Centre was also involved during the year in a number of confidential consultancies as industry continues to recognise the problem-solving capabilities and resources of the Centre. A major initiative to improve the uptake of "Laser Processing in Victoria" was completed during the year. This latter project was jointly sponsored by the Victorian Government, the Industrial Research Institute Swinburne and CRC-WS and involved cash and in-kind contributions from ASTA/Boeing, the Department of Defence (DSTO/AMRL), General Motors-Holden and two SMEs, Furphy & Sons and Harvest Engineering. The benefits gained from this initiative were significant with one SME, for example, moving from a one-shift laser cutting operation to a corporate decision to purchase a new laser for welding an array of new products.

In the coming year, further commercial opportunities and applications are envisaged to flow from Centre activities, for example:

- The commercialisation of the "Phoenix" technology
- The commencement of a major, international, collaborative project on pipeline welding involving the Centre, the Universities of Wollongong and Cranfield (UK) and the Edison Welding Institute (USA)
- Commencement of the licensed Welding Engineer Course at Cranfield (UK) and the negotiation of further international licences
- Commercialisation of software to assist the pipeline industry (with potential extension to the petrochemical industry)
- Demonstration of the use of high strength low alloy steel in naval applications
- Application of the Centre's weld monitoring technology (initially in a steelworks mill).

INVOLVEMENT OF USERS

In achieving the above R&D outcomes, the Centre has relied (and will continue to rely) on the faith and commitment of its many cash and in-kind sponsors. Achievements to date owe much to the patience, guidance and enthusiasm provided by officers of many companies who have contributed to the CRC's activities during the year. In appreciation of this valued assistance, those (non Core Participant) companies are listed below, with much appreciation from the management and Core Participants within the Centre.

Meeting of the Pipeline Program Management Committee (PMC) including researchers and sponsors (July 2001)

NON-CORE PARTICIPANT INDUSTRIAL SUPPORTERS

COMPANY	COMPANY SIZE	SUB PROGRAM
Alcan Gove	Large	Power Generation and Petrochemical
Alinta Gas	Large	Pipeline
APC Socotherm	Large	Pipeline
Austin Hospital/Monash University	Large	Joining Equipment/OH&S
BHP Newcastle Laboratories	Large	Building and Construction
Bisalloy Steels	Large	Building and Construction
Boeing – Hawker de Havilland	Large	Joining Equipment
Bogaart	SME	Building and Construction
Bredero Shaw Australia	Large	Pipeline
Brian Martin & Associates	SME	Pipeline
Brown & Root	Large	Building and Construction
Cranfield University	Large	Education/Joining Equipment
CS Energy	Large	Power Generation and Petrochemical
Delta Central Coast	Large	Power Generation and Petrochemical
Delta Western	Large	Power Generation and Petrochemical
DSTO-AMRL	Large	Building and Construction
Duke Energy	Large	Pipeline
Envestra	Large	Pipeline
Epic Energy	Large	Pipeline
Eraring Power Station	Large	Power Generation and Petrochemical
ESAB Australia	Large	Joining Equipment
FTS Technology Services	SME	All
Furphy & Sons	SME	Joining Equipment
Gas Measurement & Auditing	SME	Pipeline
GCI-Kenny	Large	Building and Construction
General Motors-Holden	Large	Joining Equipment
Goodwill Games	Large	Building and Construction
GPU-Gasnet	Large	Pipeline
Ground Support Services	SME	Joining Equipment
Harvest Engineering	SME	Joining Equipment
Hazelwood Power Station	Large	Power Generation and Petrochemical
Industrial Research Institute Swinburne	Large	Power Generation and Petrochemical
IONIC Consulting	SME	Pipeline
JP Kenny	Large	Pipeline
Kvaerner Oil & Gas	Large	Building and Construction
Lincoln Electric	Large	Joining Equipment
Loy Yang Power Station	Large	Power Generation and Petrochemical
MJ Kimber Consultants	SME	Pipeline
Marin	Large	Building and Construction
Marintek	Large	Building and Construction
McConnel Dowell Constructors	Large	Pipeline
Meanderlyn	SME	Joining Equipment
MIAB Technology	SME	Pipeline
Microalloying International	SME	Pipeline
NevCap Pty ltd	SME	Joining Equipment/OH&S
Origin Energy	Large	Pipeline
Peter Tuft & Associates	SME	Pipeline
Rail Infrastructure Corporation	Large	Building and Construction
Stanwell Corporation	Large	Power Generation and Petrochemical
Tarong Energy	Large	Power Generation and Petrochemical
Tenix Defence Systems	Large	Building and Construction
Thermadyne	Large	Joining Equipment
Tyco Water	Large	Pipeline
University of Berkeley	Large	Building and Construction
Venton & Associates	SME	Pipeline
Victorian Government Office of Manufacturing, Department of State and Regional Development	Large	Joining Equipment
WAPET	Large	Building and Construction
WIA	Large	Building and Construction
WNI Science and Technology	Large	Building and Construction
Worley	Large	Pipeline
Zentech	Large	Building and Construction

Staffing & Administration

The Headquarters of the CRC for Welded Structures is located within the Illawarra Technology Centre of the University of Wollongong. The CRC-WS operates a small central office at this location resulting in low, overall administration costs (7.0% of total costs for 2001/2).

The following table details Specified Personnel for the Centre during 2001/2002, the time committed to the Centre during the year and their function in the overall program of the CRC-WS.

The Integrated Project Management Information System (IPMIS), developed by the Centre, continues to be used for submitting project proposals and quarterly reports. Committee Minutes and Policy Directives are also available on the system to enhance communication and awareness of CRC policies and processes. Access to IPMIS is available via the worldwide web to all CRC staff, Board members, major sponsors and Participant organisations, including overseas organisations.

SPECIFIED PERSONNEL

NAME	ORGANISATION	TIME ON CRC %	FUNCTION	PROGRAM
Dr C Chipperfield	CRC-WS Head Office	100	Chief Executive Officer	Administration
Prof J Norrish	University of Wollongong	100	Program Manager	Education/ Research
Prof V Linton	Adelaide University	100	Sub-Program Manager	Education/ Research
Mr C Smallbone	WTIA	40	Program Manager	Technology Transfer
Dr K Enever	CRC-WS Head Office	70	Research Program Manager	Education/ Research
Dr F Barbaro	BHP	16	Sub-Program Manager	Research
Mr R Small	Pacific Power	28	Sub-Program Manager	Research
Mr A Forbes	WTIA	100	Manager - Technical Panels	Technology Transfer
Prof G Hancock	University of Sydney	9	Sub-Program Manager	Research
Dr B Bednarz	CSIRO-MST	32	Sub-Program Manager	Research

Patents & Publications

Ahmed N A vision for welding and joining R & D in Australia, WTIA 49th Annual Conference, October 2001, paper 6.

Alam N and Ion J C Extending the life components by laser beam cladding, Australasian Welding Journal Vol 47, 2nd Quarter pp 26-27.

Alam N , Jarvis L, Harris D and Soltan A Laser cladding – a highly promising technique to repair engineering components, WTIA 49th Annual Conference, October 2001, paper 16.

Alam N, Jarvis L, Harris D and Soltan A Laser cladding for repair of engineering components, Australasian Welding Journal Vol 47, 2nd Quarter pp 38-47.

Allan G and Beveridge P Austenitic manganese steel – repair welding as a maintenance option, WTIA 49th Annual Conference, October 2001, paper 37

Ambrose S and Moss H Risk directed asset management – past, present and future, WTIA 49th Annual Conference, October 2001, paper 8.

Booth G, Howse D, Woloszyn A, and Howard R Hybrid Nd:YAG laser/gas metal arc welding for new land pipelines, WTIA Pipeline Construction Technology Conference, March 2002, paper 12.

Bowie G and Barbaro F Assessment of workmanship defect acceptance levels in high strength thin walled pipeline girthwelds, WTIA Pipeline Construction Technology Conference, March 2002, paper 9.

Brown I Friction welding at Adelaide University, WTIA 49th Annual Conference, October 2001, paper 20.

Barbaro F Welding the first ERW X80 grade pipeline, WTIA Pipeline Construction Technology Conference, March 2002, paper 6.

Cannon B Protocol for weld repair, WTIA 49th Annual Conference, October 2001, paper F.

Cannon B G, Li H, Watson K B and Bosman M Welding consumables for galvanising kettles, Australasian Welding Journal Vol 46, 4th Quarter pp 33-38.

Cannon B and Watson K Behaviour of weld metal after long term immersion in liquid zinc, WTIA 49th Annual Conference, October 2001, paper 35.

Cannon B G and Watson K B Welding consumables for galvanising kettles – assessment of long term exposure test coupons, Australasian Welding Journal Vol 47, Ist Quarter pp 39-47.

Chipperfield C Cooperative research in Australia and its focus on welded structures, ASM/AWS 6th International Conference on Trends in Welding Research, Pine Mountain, Georgia USA, April 2002

Chipperfield C and Kimber M Pipeline research, WTIA 49th Annual Conference, October 2001, paper 7.

Choi C H New vacuum sensor for detecting surface cracks on welds, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 19.

Cimpoeru S and Alkemade S Guidelines for effective armour material specifications for defence applications, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 12.

Cole G.K, Pinna R, Ronalds B.F and Romagnolo P Investigation of a simplified fatigue reliability model for optimising the design of tubular joints, Offshore Mechanics and Arctic Engineering Conference, Oslo 2002-28055

Cuiuri D, Norrish J and Cook C New Approaches to controlling unstable gas metal arc welding, WTIA 49th Annual Conference, October 2001, paper 43.

Cuiuri.D, Cook.C, Norrish.J, Novel control techniques for Gas Metal Arc Welding, ASM/AWS 6th International Conference on Trends in Welding Research, Pine Mountain, Georgia USA, April 2002

Dagg H Welding of coated steels, WTIA 49th Annual Conference, October 2001, paper B.

Das T and A Mundy Laser forming in Australia – A new age dawns, Australasian Welding Journal Vol 46, 3rd Quarter p 11.

De Boer F and Nulsen S Filter design for welding processes, WTIA 49th Annual Conference, October 2001, paper 31

Dean G, Cuiuri D, Norrish J and Cook, C A versatile experimental test rig for GMA welding research, Australasian Welding Journal Vol 46, 3rd Quarter pp 33-38.

Dixon B Materials and joining technologies for modern submarine fabrication, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 1.

Doe S Microjoining at CSIRO, WTIA 49th Annual Conference, October 2001, paper 19.

Doe S Microjoining in a big world, WTIA 49th Annual Conference, October 2001, paper 17.

Dunne D Hot cracking, WTIA 49th Annual Conference, October 2001, paper H.

Dunne D, Nolan D, Norrish J and Fletcher L Solidification cracking and other defects in cellulosic weld metals, WTIA 49th Annual Conference, Adelaide, October 2001, paper 30.

Francis JA, Bednarz B and Bee JV Prediction of steady state dilution in multipass hardfacing overlays deposited by self shielded flux cored arc welding, Science and Technology of Welding and Joining (UK), vol. 7, no. 2, pp. 95-106, April 2002.

Garrett G Opening address, WTIA 49th Annual Conference, October 2001

Gerrard D, Hinton B, Trathen P and Bushell P Metallic coatings and environmentally induced hydrogen embrittlement of ultra high strength steel, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 17.

Patents & Publications

Henderson I Developments in friction stir welding and commercial applications, WTIA 49th Annual Conference, October 2001, paper 22.

Henderson I Laser fabrication of structural components – overseas developments, WTIA 49th Annual Conference, October 2001, paper 13.

Henderson I Microjoining technology – some overseas developments, WTIA 49th Annual Conference, October 2001, paper 18.

Hermann M Defence industries and technological advancement – a microcosm of Australia's industry environment, WTIA 49th Annual Conference, October 2001, paper 2.

Huang S W, Dean G, Norrish, J and Nolan D Process improvements for coated steel welding in DIP transfer gas metal arc welding, WTIA 49th Annual Conference, October 2001, paper 47.

Huang S W, Dean G, Norrish, J and Nolan D Welding process improvements for coated steel using dip transfer gas metal arc welding, Australasian Welding Journal Vol 47, Ist Quarter pp 33-38.

Hughes R Weld repair of high strength stainless steel in an army gun carriage, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 11.

Ion J Trends in industrial applications of laser welding, WTIA 49th Annual Conference, October 2001, paper 12.

Ion J Welding and other metal fabrication technologies at CSIRO manufacturing Science and Technology in Adelaide, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 26.

Jarvis L, Baughn K, Ahmed N and Viano D Tailoring the phase balance during laser and GTA keyhole welding of SAF 2205 Duplex Stainless Steel, ASM/AWS 6th International Conference on Trends in Welding Research, Pine Mountain, Georgia USA, April 2002

Killmore C The evolution of modern HSLA structural steels, WTIA 49th Annual Conference, October 2001, paper A.

Law M and Fletcher L Modelling of plasticity in hydrostatic testing of gas pipelines, WTIA Pipeline Construction Technology Conference, March 2002, paper 19.

Linton V Welding of dissimilar metals, WTIA 49th Annual Conference, October 2001, paper D.

Linton V, Wilson P, Jones C, Thomsen S J, Laycock N and Tuck P Risk management during selection of corrosion resistant alloys, WTIA 49th Annual Conference, October 2001, paper 24.

Nolan D, Dunne D, Norrish J and Fletcher L Hot cracking in cellulosic pipeline girth welds, WTIA Pipeline Construction Technology Conference, March 2002, paper 10.

Norrish J Fusion control in dip transfer GMA welding WTIA 49th Annual Conference, Adelaide, October 2001, paper 28.

Norrish J Mechanised girthwelding options for high strength thin wall pipelines, WTIA Pipeline Construction Technology Conference, March 2002, paper 15.

Norrish J Recent developments in post graduate welding education in Australia, WTIA 49th Annual Conference, October 2001, paper 42.

Norrish J Developments in the GMAW process and power sources for welding of steel, WTIA 49th Annual Conference, October 2001, paper I

Norrish J Keynote Address, Monitoring and control of welding processes, ASM/AWS 6th International Conference on Trends in Welding Research, Pine Mountain, Georgia USA, April 2002

Norrish.J Fume generation and control in GMA welding, 6th international Conference on Trends in Welding Research, ASM/AWS 6th International Conference on Trends in Welding Research, Pine Mountain, Georgia USA, April 2002

Norrish J,Dean G,Cuiuri D and Cook C, A new approach to controlled short circuit transfer in GMAW, Recent Developments and Future Trends in Welding Technology, Cranfield University, UK, September 2001

Norrish J, Australian research in welding fume generation and control, AIOH19th Annual Conference, Wollongong, December 2001.

Nulsen S and De Boer F Identification of defects for resistance welding processes, WTIA 49th Annual Conference, October 2001, paper 46.

O'Neill L, O'Brein S and Fakas E Parametric investigation of the stability of vessels for float–over deck transportation, Offshore Mechanics and Arctic Engineering Conference, Oslo 2002-28217

Osborne G, Krishnan K N and Brown I Friction stir welding of aluminium alloy 6061, WTIA 49th Annual Conference, October 2001, paper 21.

Phillips R, Ritter J, Donato J, Barbaro F, O'Brien D, Brown I, Powell G, Norrish J, Chipperfield C and Jones M Assessment of X80 grade steel in an ANZAC frigate, WTIA 49th Annual Conference, October 2001, paper 36.

Phillips R, Ritter J, Donato J, Barbaro F, O'Brien D, Brown I, Powell G, Norrish J, Chipperfield C and Jones M Assessment of X80 grade steel in an ANZAC frigate, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 23.

Pilotto M, Ronalds B.F and Stocker R The dynamic sensitivity of monopod platforms in the wave zone, AIOM, 2002-08-29

Pilotto M, Ronalds, B.F and Stocker, R Dynamic response of shallow water monopod platforms, Offshore Mechanics and Arctic Engineering Conference, Oslo 2002-28072

Pitrun M Cold cracking, WTIA 49th Annual Conference, October 2001, paper G.

Pitrun M and Nolan D Hydrogen induced cracking in flux-cored weldments, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 15.

Powell G, Brown I, Davidson L and Linton V Cold cracking and segregation in multipass welds of a quenched and tempered steel, ASM/AWS 6th International Conference on Trends in Welding Research, Pine Mountain, Georgia USA, April 2002

Powell G and Brown I Hardfacing – a new approach to vastly improve performance, WTIA 49th Annual Conference, October 2001, paper 45.

Ronalds B.F, Bjarke T and Trinh S Influence of non-proportional environmental loading on the reliability of production jack-ups, International Journal of Offshore Mechanics and Arctic Engineering

Ronalds B.F Surface production system options for deepwater, Offshore Mechanics and Arctic Engineering Conference, Oslo 2002-28143

Ronalds B.F Deepwater facility selection Offshore Technology Conference, Houston May 2002 14259

Salagaras M, Bushell P and Hinton B Effects of friction stir welding on the general corrosion and stress corrosion cracking resistance of aluminium alloy 7075-T651, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 9.

Siminski M and De Boer F Building strategies for rapid prototyping and wear replacement by gas metal arc welding, WTIA 49th Annual Conference, Adelaide, October 2001, paper 34.

Simpson G Adhesive bonding in the maritime industry, WTIA Technological & Research Developments in Welded Defence Equipment Conference, March 2002, paper 10.

Simpson S Statistical methods for quality control in resistance spot welding and continuous welding, WTIA 49th Annual Conference, October 2001, paper 48.

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PATENTS

During the year, the CRC for Welded Structures Limited jointly with CSIRO filed three Provisional Patent Applications for CONSUMABLE ELECTRODE ARC WELDING.

Public Presentations Public Relations & Communication

Introduction

Technology diffusion, defined as "sourcing and dissemination of information by various means, assessment of this information by the recipients and its successful adaptation and application" forms the essential link between research and industry.

As the Technology Transfer Core Partner of the CRC-WS the WTIA, through its SMART TechNet Project plays a leading role in the complete cycle of technology diffusion for the Australian welding industries.

- WTIA Technical Panel, SMART and Industry Specific Group members and APIA members actively sponsor and participate in CRC-WS research activities.
- Members of these groups form part of Technology Expert Groups responsible for the development of Expert Technology Tools (ETTs) designed specifically for industry, particularly Small and Medium Enterprises (SMEs). An ETT is a medium for diffusion and take-up of technological information based on global research and development and experience to improve industry performance. It can be formatted as a hard copy, software (fixed, interactive or modifiable), audiovisual (videos and sound tapes) or physical samples. It can be complemented by face-to-face interaction, on-site and remote assistance, training modules and auditing programs. Technology Expert Group members and the resultant ETTs facilitate the diffusion and take up of relevant technology, including appropriate CRC outputs, by industry. During the financial year, 104 workshops were conducted by the WTIA throughout Australia introducing ETTs to industry.
- Technology forums and exhibitions initiated and organised by WTIA and APIA facilitate technology diffusion to industry, as well as promote CRC-WS education programs, services and facilities. Feedback from such forums is important in assessing further technology needs of companies, particularly SMEs.
- Overseas industry study missions organised by the WTIA introduce both research and industry personnel to the latest advances in welding technology in the world as well as promote Australian R&D and industrial capabilities. These visits complement the contacts made when overseas experts visit specific CRC sites.
- WTIA and other publications including the Internet are excellent media for the dissemination of information about CRC programs, projects and activities to industry
- The assessment of technology take-up and value in industry is an integral part of the SMART TechNet Project and an essential element in successful diffusion.
- Through its qualification and certification programs, WTIA is actively promoting the creation of technology receptors in industry i.e. engineers, technologists, specialists and practitioners.
- The success of the SMART TechNet Project and its high profile with both State and Federal governments and industry as a whole is a key element in the general promotion and raised profile of the welding industry in Australia. The Institute's involvement with broad-based technology diffusion networks from a variety of related non-welding industry sectors ensures benchmarking with current initiatives.

These media of technology diffusion allow the effective dissemination of information about, and outputs from, CRC sponsored projects into industry. They also facilitate communication with industry and technology needs analyses of various sectors, which ensures the development of appropriate projects with a high likelihood of industry sponsorship. Utilisation of and participation in the WTIA OzWeld network by CRC Core Partners also ensure effective monitoring of international technology and current world R&D.

Technology Forums and Exhibitions

The following summary of technology forums and exhibitions highlights the pro-active role taken by the Core Partners in this important area.

WTIA 49th Annual Conference

A total of 35 papers were presented by CRC Core Partners at this event held in October on the theme of "Challenges for Innovation for the New Millennium". 127 people attended the conference and its associated site visits. In addition, papers were presented by delegates from Bahrain, Austria, Singapore, Korea, USA and Japan, amongst others. The Opening Address was given by Dr Geoff Garrett, Chief Executive of CSIRO, speaking on working positively to build a better future for Australia. A trade exhibition highlighted the work of the CSIRO as well as other Core Partners through the WTIA/CRC-WS stand. Site visits enabled both industry and international representatives to attend the facilities at the University of Adelaide and CSIRO and were invaluable in terms of technology diffusion and the promotion of Core Partner facilities and services.

At the University's Centre for Electron Microscopy and Microscopic Analysis (CEMMSA), delegates saw demonstrations of scanning electron microscopy and field emission analysis as well as transmission electron microscopy of thin foils. At the Thebarton Campus delegates attended a demonstration of friction stir welding of aluminium plates - a unique opportunity to see this technology in action. Samples of thick-plate welds were available for inspection, as were various machine tools for welding of aluminium extrusions.

An extended visit was made to CSIRO Manufacturing Science and Technology at Woodville North to enable the delegates to see:

- Robot welding cell manufacturing steering column parts at Cooper Standard Automotive, a company located adjacent to the CSIRO laboratories, which has collaborated with CSIRO to develop and implement robotic arc welding;
- Narrow gap thick section welding technology being used for joining of both steel and aluminium weldments;
- Pilot plant for experimental flux cored wire manufacturing and evaluation;
- Pilot ferrous foundry for development of novel casting technology, including direct casting of composite wear-resistant plates;
- Computer aided metal forming operations using industrial robots to undertake complex forming tasks;
- Single-pass key-hole TIG welding technology for welding of relatively thick walled pipe in stainless steels and titanium alloys;
- Laser materials processing demonstrations using the 3.5 kW Nd:YAG laser interfaced with an industrial robot.

By timing a WTIA Technical Panel 14 *Arc physics* meeting during the week, members were able to capitalise on the presence of a number of industry and visiting overseas representatives.

Residual Stress Measurement using Neutrons

This technology demonstration forum was held by WTIA in conjunction with ANSTO to promote the facilities currently being built at that establishment. A total of 124 representatives from industry in 5 centres around Australia heard presentations by ANSTO staff and Dr Tom Holden from Los Alamos National Laboratory, USA focussing on the application of neutron diffraction techniques to measuring residual stress in engineering components. This non-destructive technique is expected to be invaluable to manufacturing companies and researchers and the free workshops were an excellent way for people to learn of the potential of the technology. A number of enquiries for future use of the facility have already been generated.

Pipeline Construction Technology

The annual WTIA International Pipeline Conference in March 2002 focused on Pipeline Construction Technology with over 80 delegates attending the conference and two workshops in Wollongong. With speakers from USA, Europe, Asia and Australian industry, very positive outcomes were achieved at the conference in terms of technology transfer and industry networking. Six papers were presented by CRC-WS Core Partners. Two workshops were also held during the week.

The Pipeline Inspection Workshop focussed on the various relevant standards, as well as field NDT, mechanical testing and consumables. The delegates then travelled to BHP Steel Central Laboratory to see a demonstration of wide-plate testing, developed as a CRC-WS project, to AS 2885.2 criteria. A Mechanised Girth Welding Workshop was run at the facilities of the University of Wollongong, show-casing the work undertaken by this University and the University of Adelaide through the CRC-WS for the Australian pipeline industry.

Pipeline industry representatives at a demonstration of Wide Plate Testing

Welded Defence Equipment

WTIA's first International Conference on Technological and Research Developments in Welded Defence Equipment was held in conjunction with CRC-WS Core Participant DSTO in Melbourne in March. The Keynote Address was given by Mr Mick Roche, Under Secretary, Defence Materiel Organisation. A total of 26 papers were presented, 13 from overseas authors and 11 from CRC-WS personnel. The 60 delegates, top level research and decision makers, contributed actively to the development of a number of positive resolutions and actions for future activities, focussing on the building up of a R&D capability for the defence industry in Australia and the utilisation and support of the OzWeld Technology Support Centres Network and the SMART TechNet Project. With increased government focus on defence and defence spending in Australia, this is a key area of great potential for the welding industry and welding research.

National Manufacturing Week Exhibition

National Manufacturing Week was held in Sydney from 28 to 31 May 2002 with over 13,000 visitors attending over the four days. This major engineering exhibition included 540 sq m of welding, joining and heat treatment exhibition stands in a Pavilion organised for industry by the WTIA. This entire Pavilion carried alternate fascias promoting the CRC-WS. Feedback from all exhibitors in the Pavilion was excellent, with large numbers of relevant enquiries received from industry visitors.

Latest developments in welding technology, qualification and certification and CRC-WS activities were showcased at the joint WTIA/CRC-WS stand. The stand was manned by WTIA staff for the duration of the exhibition, with over 750 promotional packs including CRC-WS material distributed during the four days. Visitors to the stand were recorded for further follow up.

OTHER PRESENTATIONS

Papers were presented by CRC-WS Core Partner personnel at the following additional conferences:

- ASM/AWS 6th International Conference on Trends in Welding Research, Pine Mountain, Georgia USA, April 2002.
- 54th Annual Assembly of the International Institute of Welding, Slovenia, July 2001
- 55th Annual Assembly of the International Institute of Welding in Denmark, June 2002
- Offshore Mechanics and Arctic Engineering Conference, Norway, 2002
- Offshore Technology Conference, Houston USA, May 2002
- Australian Conference on Applied Mechanics, Sydney, 2002
- Conference on Railway Engineering, Institution of Engineers Australia, Wollongong, 2002
- 10th Asia-Pacific Conference on Non-Destructive Testing
- Recent Developments and Future Trends in Welding Technology, Cranfield University, UK, September 2001
- AIOH19th Annual Conference, Wollongong, December 2001.

OVERSEAS CONTACTS

With Australia producing only 2% of the total world R&D, it is extremely important that CRC partners maintain good communication with developments overseas in their fields; to avoid any duplication of effort, to build upon work already done, and to ensure that Australian R&D successes and facilities are well promoted internationally. This can be assisted by study missions overseas and through visits to CRC sites by international experts.

As the Australian member body of the International Institute of Welding, the WTIA brings extensive international contacts to the CRC. Contacts are also facilitated by the extensive overseas membership of the OzWeld Technology Support Centres Network which includes: Deutscher Verband fur Schweisstechnik (Germany), Edison Welding Institute (USA), FORCE Technology (Denmark), GKSS Forschungszentrum GMbH (Germany), Heavy Engineering Research Association (New Zealand), Materials Properties Council (USA), Pressure Vessel Research Council (USA), The Welding Institute (UK), Otto-Von-Guericke University Magdeburg (Germany), E.O. Paton Electric Welding Institute and the Welding Research Council (USA).

INDUSTRY MISSION TO EASTERN EUROPE

A tour of four key technology and research centres by representatives from DSTO, CIGWELD and WTIA took place in July 2001. The National Welding Institutes of the Ukraine, Poland, Slovakia and the Technical University of Vienna were visited. Leading edge technologies were observed and discussions took place to bring such technologies into Australian industry. The E.O. Paton Electric Welding Institute became a Member of the WTIA OzWeld Technology Support Centres Network.

Delegates also participated in the 54th Annual Assembly of the International Institute of Welding. Prof Ian Henderson and Mr Chris Smallbone of the WTIA represented Australia at the General Assembly Meetings where Mr Smallbone was elected a Vice President of IIW for the term 2001-2004. Mr Smallbone also gave a presentation to the General Assembly in his role as Chairman, IIW Board of Directors Working Group Regional Activities and Liaison with Developing Countries.

TECHNOLOGY AND RESEARCH IN THE USA

A tour of six key technology and research centres by representatives from CSC-WS, CSIRO, University of Wollongong, University of Adelaide and WTIA took place in conjunction with the presentation of 7 papers by representatives at the ASM/AWS 6th International Conference on “Trends in Welding Research” at Pine Mountain, Georgia USA in April.

Organisations visited were:

- National Institute of Standards and Technology - Bouler
- Colorado School of Mines - Golden
- Edison Welding Institute - Columbus
- Ohio State University - Columbus
- Oak Ridge National Laboratories
- Electrical Power Research Institute (EPRI) - Charlotte

EXHIBITION	LOCATION	VISITORS
Trade exhibition in conjunction with the WTIA 49th Annual Conference	Adelaide, SA	127
Trade exhibition in conjunction with the International Conference on Pipeline Construction Technology	Wollongong, NSW	80
Trade exhibition in conjunction with International Conference Technological and Research Developments in Welded Defence Equipment	Melbourne, Vic	60
Welding Joining and Heat Treatment Pavilion, National Manufacturing Week 2002	Sydney, NSW	13,000

An extensive number of contacts with world experts were made by each member of the group with the potential for a significant number of collaborative projects between the USA and Australian researchers. Draft action plans were made to implement joint welding technology programs to the mutual benefit of both countries.

INDUSTRY MISSION TO GERMANY AND DENMARK

The further industry-focussed trip organised by the WTIA comprised ten Australian representatives visiting seven leading manufacturing organisations and five key technology centres in Germany and Denmark, followed by participation in the IIW Annual Assembly in Copenhagen. Representatives of 3 CRC Core Partners attended the tour. Sixteen Australian delegates also attended the IIW Annual Assembly program in Denmark, with 6 CRC personnel representing Australia at various Commission meetings, and 3 papers presented.

Technology centres visited included:

- GKSS Forschungszentrum GMbH (Institute for Materials Research) – Hamburg
- SLV Duisburg – Dusseldorf
- University of Aachen – Aachen
- Fraunhofer Laser Institute – Aachen
- FORCE Technology - Copenhagen

Companies visited were:

- STILL Gmbh - Hamburg
- GKSS Forschungszentrum GmbH (Institute for Materials Research) - Hamburg
- Blohm + Voss - Hamburg
- Europipe Deutschland GmbH - Dusselforf
- Daimler-Chrysler AG (Sprinter-Werk) - Dusselforf
- Siemens AG (Duwag) - Dusselforf
- Odense Steel Shipyard - Copenhagen

The mission was a resounding success for all participants who will initiate steps for Australian companies to become more exposed to the latest developments in technology and industrial fabrication through the contacts made at the various companies/organisations visited. Particular note was made of the utilisation of technology in shipbuilding, particularly friction stir welding and robotics, as well as the reliance upon well trained personnel to act as technology receptors in a company.

OVERSEAS VISITORS

A number of international experts visited CRC-WS sites during visits to Australia. These included:

- Dr Vladimir Kachinskiy from E.O. Paton Electric Welding Institute, Ukraine
- Prof Horst Herold from Otto-von-Guericke-University, Magdeburg, Germany
- Dr Norman Stockham and Dr Geoff Booth from TWI UK
- Mr Arrie van Niekerk from South Africa
- Prof Torgeir Moan, Norwegian University of Science and Technology

Valuable discussions were held with CRC-WS personnel, and meetings with industry representatives were arranged by the WTIA where possible.

PUBLICATIONS

A full listing of publications by CRC Core Partner personnel is given elsewhere in this report. The CRC sponsored the Welding Research Supplement of the Australian Welding Journal, published by the WTIA on a quarterly basis, continues to provide an excellent forum for CRC research outputs. The Journal, which has a distribution of 4,000 both within Australia and overseas, and all WTIA conference proceedings are indexed in the international bibliographic database Weldasearch maintained by the TWI.

Linked Internet sites are maintained by the WTIA and CRC-WS, as well as the Core Partners. These capitalise on the extensive communication networks now available through the electronic media.

The Joining Forces newsletter continues to fulfil a role of internal communication between Core Partners, as well as promoting CRC activities to a broader audience based upon WTIA's corporate and sustaining membership.

Grants & Awards

During the year, the CRC for Welded Structures established a spin-off company, JoinTechnology Pty Ltd, which was awarded $87k in the form of a COMET Grant (2001-1328) for the commercialisation of the "Phoenix Technology".

CRC-WS in conjunction with the Industrial Research Institute Swinburne (IRIS) was awarded a grant by the Victorian State Government for a project on increasing the adoption of laser welding technology by Victorian industry. The project established a user group of companies and identified potential parts for laser processing. Industry members comprised J Furphy and Sons (WTIA Large Fabricator of the Year 2000), DSTO, GMH, Harvest Engineering and Hawker de Havilland.

The aim of this project was to assist Furphy to develop procedures and laser parameters for producing quality welds in refrigeration jackets made from SS 304 and mild steel sheet. A number of refrigeration jackets were prepared and examined for weld quality and penetration. Furphy have now implemented the recommendations made in a report on this project and have commenced production of the refrigeration plates. In addition to contributing to the development of laser welding for the manufacture of the plates, the project has allowed Furphy to increase their cutting capability through the better understanding of the laser system itself.

CRC-WS Board member, Chris Smallbone, Executive Director of the WTIA was awarded the prestigious Dr Wilfred Chapman Award at the Annual WTIA Awards dinner in May. This is the highest individual award of the Institute, and was made for outstanding contributions to the promotion, development and recognition of welding technology in Australian industry both locally and internationally. During this year, Mr Smallbone was also appointed Vice President of the International Institute of Welding for the term 2001-2004.

Two papers written by CRC-WS Core Partner personnel received awards for outstanding achievement through the WTIA. Both papers were published in the proceedings of the 49th Annual WTIA Conference, "Challenges for innovation in the new millennium" held in Adelaide in October 2001.

Sir William Hudson Memorial Award – Best Published Research Paper:
Dominic Cuiuri, John Norrish and Christopher Cook (University of Wollongong)
"New approaches to controlling unstable GMAW"

A. Ramsay Moon Award – Best Published Industry Paper:
John Ion (CSIRO, Adelaide)
"Trends in industrial applications of laser welding"

Institutional grants submitted or for which research progressed during 2001/2 are shown below:

Project	Student/Supervisors	Industry Sponsor	Status
Mobile High Power Diode Laser for Thermal Processing Applications	A/Prof Milan Brandt, Prof John Norrish (UoW), Dr Paul Di Pietro, Dr David Nolan, Messrs CR Nararajah, SH Masood	--	LIEF Grant proposal submitted
Fume Plume Distribution (ARC Linkage)	Mr Geoff Slater, A/Prof Paul Cooper Prof John Norrish (UoW)	WTIA Panel 9	Initial experimental work and modelling complete. Validation and thesis write up in progress.
Post Weld Heat Treatment of Pressure Vessels (ARC Linkage)	Mr Zoran Sterjowski Prof Druce Dunne (UoW) Mr Stan Ambrose (WTIA)	WTIA Panel 1	Experimental work in progress.
Intelligent Polymer Welding Fume Exposure Sensor (ARC Linkage)	Jeffrey Jin Prof Gordon Wallace (UoW)	WTIA Panel 9	Experimental work in progress
Power Source Process Interactions (ARC Large)	Profs John Norrish and Chris Cook (UoW) Prof S J Na (KAIST, Korea)	--	Awarded ($160,000 - 3 years). Experimental work complete
Modelling Metal Transfer (KOSEF)	Prof S J Na (KAIST, Korea) Prof John Norrish (UoW)	--	Awarded ($100,000 - 3 years)
In-Situ Analysis of Dynamic and Equilibrium Chemistry of Welding Fume	Prof Valerie Linton, Mr Ian Brown	WTIA Panel 9	Proposal (ARC Linkage)
Erosion/Corrosion Wear Resistant Coatings for the Mining/Mineral Processing Industries	Mr Ian Brown	WTIA Panel 8	Proposal (ARC Linkage)

Performance Indicators

	CRC for Welded Structures for 99/00	CRC for Welded Structures for 00/01	CRC for Welded Structures for 01/02
COOPERATIVE ARRANGEMENTS			
Average number of Core Participants involved in each project	3.3	3.6	2.9
% of projects with involvement of ⩾ 2 Core Participants	100%	100%	97%
% of projects initiated by industry	80%	85%	83%
% of projects involving international collaboration	44%	52%	43%
RESEARCH AND RESEARCHERS			
On-time project milestone achievement	69%	75%	79%
Number of research publications	80	68	79
Number of publications in refereed journals	14	10	9
Number of publications at international conferences	39	51	70
Number of patents (including provisionals)	2	3	5
Visits to the CRC by overseas experts	30	23	21
EDUCATION AND TRAINING			
Number of postgraduates qualified	11	11	15
Number of postgraduates enrolled in research	57	59	47
APPLICATION OF RESEARCH			
Number of projects implemented in industry	10	7	9
Number of Workshops/Seminars held*	39	146	26*
Number of WTIA Panel Meetings	31	29	29
Total attendees at Panel Meetings	383	331	319
Industry attendees at Panel Meetings	247	210	210
Number of industrial consultations**	1,353	1,473	1,800
MANAGEMENT AND BUDGET			
Industrial cash funding received ($k)	886	906	1,166
Financial Reporting	Monthly	Monthly	Monthly
% of projects within budget	100	100	100
% Administration cost	8.9	7.9	7.0

* Does not include the 65 WTIA Divisional evening meetings, 104 ETT workshops or forums not specifically related to CRC-WS activities.

** The CRC-WS supports the WTIA SMART TechNet Project Hotline and State Technology Managers consultation service to industry. This figure does not include in-depth company assistance.

BUDGET

TABLE 1: IN-KIND CONTRIBUTION FROM PARTICIPANTS (2001/02) ($'000)

	Actual 1999/00	Actual 2000/01	Actual 2001/02	Agreement 2001/02	Cumulative To Date Actual	Cumulative To Date Agreement	Agreement 2002/03	Agreement 2003/04	Agreement 2004/05	Agreement 2005/06	Grand Total
PARTNERS											
University of Wollongong											
Salaries	520	411	412	188	1,343	564	188	188	188	188	2,095
Capital				80		222	80	90	90	90	350
Other	809	936	1,070	441	2,815	1,323	441	441	441	441	4,579
Total	1,329	1,347	1,482	709	4,158	2,109	709	719	719	719	7,024
The University of Adelaide											
Salaries	105	131	170	257	406	771	257	257	257	257	1,434
Capital				40		110	40	45	45	45	175
Other	572	535	621	328	1,728	984	328	328	328	328	3,040
Total	677	666	791	625	2,134	1,865	625	630	630	630	4,649
The University of Sydney											
Salaries	52	27	20	120	99	360	120	120	120	120	579
Capital	10				10						10
Other	246	186	111	180	543	540	180	180	180	180	1,263
Total	308	213	131	300	652	900	300	300	300	300	1,852
The University of Western Australia											
Salaries	160	182	160	68	502	204	68	68	68	68	774
Capital											
Other	375	417	389	207	1,181	621	207	207	207	207	2,009
Total	535	599	549	275	1,683	825	275	275	275	275	2,783
CSIRO Manufacturing Science and Technology											
Salaries	267	137	172	213	576	631	213	216	216	216	1,437
Capital				80		180	80	90	90	90	350
Other	529	344	448	318	1,321	1,000	318	315	315	315	2,584
Total	796	481	620	611	1,897	1,811	611	621	621	621	4,371
Australian Nuclear Science and Technology Organisation											
Salaries	81	64	58	84	203	252	84	84	84	84	539
Capital											
Other	243	269	220	141	732	423	141	141	141	141	1,296
Total	324	333	278	225	935	675	225	225	225	225	1,835
Commonwealth Department of Defence (DSTO)											
Salaries	21	23	50	32	94	96	32	32	32	32	222
Capital											
Other	44	55	97	18	196	54	18	18	18	18	268
Total	65	78	147	50	290	150	50	50	50	50	490
Pacific Power											
Salaries	28	17	27	32	72	96	32	32	32	32	200
Capital											
Other	94	83	101	68	278	204	68	68	68	68	550
Total	122	100	128	100	350	300	100	100	100	100	750

TABLE 1: IN-KIND CONTRIBUTION FROM PARTICIPANTS (2001/02) ($'000) *continued*

	Actual 1999/00	Actual 2000/01	Actual 2001/02	Agreement 2001/02	Cumulative To Date Actual	Cumulative To Date Agreement	Agreement 2002/03	Agreement 2003/04	Agreement 2004/05	Agreement 2005/06	Grand Total
The Broken Hill Proprietary Company Limited											
Salaries	189	99	122	112	410	377	112	112	112	112	858
Capital											
Other	348	203	202	138	753	463	138	138	138	138	1,305
Total	537	302	324	250	1,163	840	250	250	250	250	2,163
Welding Technology Institute of Australia											
Salaries	322	356	340	231	1,018	693	231	231	231	231	1,942
Capital											
Other	129	142	110	219	381	657	219	219	219	219	1,257
Total	451	498	450	450	1,399	1,350	450	450	450	450	3,199
Comweld Group Pty Ltd (Cigweld)											
Salaries	37	45	19	60	101	180	60	60	60	60	341
Capital	10	10			20						20
Other	46	46	32	40	124	120	40	40	40	40	284
Total	93	101	51	100	245	300	100	100	100	100	645
Australian Pipeline Industry Association Incorporated											
Salaries	73	90	96	90	259	270	90	90	90	90	619
Capital											
Other	11	11	5	10	27	30	10	10	10	10	67
Total	84	101	101	100	286	300	100	100	100	100	686
The Welding Institute (TWI)											
Salaries	42	43	33	36	118	108	36	36	36	36	262
Capital											
Other	60	60	75	64	195	192	64	64	64	64	451
Total	102	103	108	100	313	300	100	100	100	100	713
Agility Team Build Pty Ltd											
Salaries	30	33	14	36	77	90	36	36	36	36	221
Capital											
Other	53	60	21	56	134	140	56	56	56	56	358
Total	83	93	35	92	211	230	92	92	92	92	579
Woodside Energy Limited											
Salaries	9	13	13	40	35	100	40	40	40	40	195
Capital											
Other	12	18	45	40	75	100	40	40	40	40	235
Total	21	31	58	80	110	200	80	80	80	80	430
OneSteel											
Salaries		12	5	40	17	50	40	40	40	40	177
Capital											
Other		13	19	40	32	50	40	40	40	40	192
Total		25	24	80	49	100	80	80	80	80	369
TOTAL CORE IN-KIND CONTRIBUTIONS											
Salaries	1,936	1,683	1,711	1,639	5,330	4,842	1,639	1,642	1,642	1,642	11,895
Capital	20	10		200	30	512	200	225	225	225	905
Other	3,571	3,378	3,566	2,308	10,515	6,901	2,308	2,305	2,305	2,305	19,738
Total	5,527	5,071	5,277	4,147	15,875	12,255	4,147	4,172	4,172	4,172	32,538

TABLE 1: IN-KIND CONTRIBUTION FROM PARTICIPANTS (2001/02) ($'000) *continued*

	Actual 1999/00	Actual 2000/01	Actual 2001/02	Agreement 2001/02	Cumulative To Date Actual	Cumulative To Date Agreement	Agreement 2002/03	Agreement 2003/04	Agreement 2004/05	Agreement 2005/06	Grand Total
ASSOCIATE RESEARCH PARTICIPANTS											
Swinburne University											
Salaries			22		22						22
Capital											
Other			46		46						46
Total			68		68						68
TOTAL CORE AND ASSOCIATE IN-KIND CONTRIBUTIONS											
Salaries	1,936	1,683	1,733	1,639	5,352	4,842	1,639	1,642	1,642	1,642	11,917
Capital	20	10		200	30	512	200	225	225	225	905
Other	3,571	3,378	3,612	2,308	10,561	6,901	2,308	2,305	2,305	2,305	19,784
Total	5,527	5,071	5,345	4,147	15,943	12,255	4,147	4,172	4,172	4,172	32,606
SUPPORTING INDUSTRY PARTICIPANTS											
Industry											
Salaries	30		256	124	286	335	149	174	199	224	1,032
Capital											
Other	134		341	474	475	1,295	549	624	699	774	3,121
Total	164		597	598	761	1,630	698	798	898	998	4,153
Incremental In-kind											
Salaries				288		830	265	205	161	73	704
Capital											
Other				862		2,490	795	615	484	217	2,111
Total				1,150		3,320	1,060	820	645	290	2,815
TOTAL IN-KIND CONTRIBUTIONS (CORE, IN-KIND & SUPPORTING)											
Salaries	1,966	1,683	1,989	2,051	5,638	6,007	2,053	2,021	2,002	1,939	13,653
Capital	20	10		200	30	512	200	225	225	225	905
Other	3,705	3,378	3,953	3,644	11,036	10,686	3,652	3,544	3,488	3,296	25,016
GRAND TOTAL (IN-KIND) (T1)	5,691	5,071	5,942	5,895	16,704	17,205	5,905	5,790	5,715	5,460	39,574

TABLE 2: CASH CONTRIBUTIONS (2001/02) ($'000)

	Actual 1999/00	Actual 2000/01	Actual 2001/02	Agreement 2001/02	Cumulative To Date Actual	Cumulative To Date Agreement	Agreement 2002/03	Agreement 2003/04	Agreement 2004/05	Agreement 2005/06	Grand Total
PARTICIPANTS											
University of Wollongong	50	50	50	50	150	150	50	50	50	50	350
The University of Adelaide	50	50	50	50	150	150	50	50	50	50	350
The University of Sydney	50	50	50	50	150	150	50	50	50	50	350
The University of Western Australia	25	25	25	25	75	75	25	25	25	25	175
CSIRO Manufacturing											
Science and Technology	50	50	50	50	150	150	50	50	50	50	350
Australian Nuclear Science and Technology Organisation	50	50	50	50	150	150	50	50	50	50	350
Commonwealth Department of Defence (DSTO)	25	25	35	25	85	75	25	25	25	25	185
Pacific Power	50	50	50	50	150	150	50	50	50	50	350
The Broken Hill Proprietary											
Company Limited	165	152	115	115	432	432	115	115	115	115	892
Welding Technology Institute of Australia			5		5						5
Comweld Group Pty Ltd (Cigweld)	100	100	50	100	250	300	100	100	100	100	650
Australian Pipeline Industry Association Incorporated	30	30	30	30	90	90	30	30	30	30	210
Agility Team Build Pty Ltd	32	64	64	64	160	160	64	64	64	64	416
Woodside Energy Limited	40	80	80	80	200	200	80	80	80	80	520
OneSteel		20	100	80	120	100	80	80	80	80	440
TOTAL CASH FROM CORE PARTICIPANTS	717	796	804	819	2,317	2,332	819	819	819	819	5,593
ASSOCIATE PARTICIPANTS											
Swinburne University			20		20						20
JoinTechnology Pty Ltd			41		41						41
TOTAL CASH FROM CORE AND ASSOCIATE PARTICIPANTS	717	796	865	819	2,378	2,332	819	819	819	819	5,654
SUPPORTING INDUSTRY PARTICIPANTS											
Industry	508	385	576	1,426	1,469	3,803	1,626	1,826	2,026	2,226	9,173
OTHER CASH - COMMERCIALISATION, etc.	19	53	105	685	177	1,380	895	1,105	1,315	1,525	5,017
FUNDING FROM THE CRC GRANT	2,242	2,168	2,100	2,100	6,510	6,510	1,600	1,600	1,330	500	11,540
TOTAL CRC CASH CONTRIBUTION (T2)	3,486	3,402	3,646	5,030	10,534	14,025	4,940	5,350	5,490	5,070	31,384
CASH CARRIED OVER FROM PREVIOUS YEAR (=UB for previous year)		188	268				385				
Less: UNSPENT BALANCE (UB)	188	268	385		385						
TOTAL CASH EXPENDITURE (T3)	3,298	3,322	3,529	5,030	10,149	13,395	5,325	5,350	5,490	5,070	31,384
CASH EXPENDITURE											
Salaries	1,952	2,001	2,324	2,736	6,277	7,563	3,172	3,056	3,136	3,075	18,716
Capital	70	32		235	102	670	200	260	225	260	1,047
Other	1,276	1,289	1,205	2,059	3,770	5,162	1,953	2,034	2,129	1,735	11,621
TOTAL CASH EXPENDITURE	3,298	3,322	3,529	5,030	10,149	13,395	5,325	5,350	5,490	5,070	31,384

Note: The above statement includes Income and Expenditure of $41K received and incurred, respectively, by JoinTechnology Pty Ltd which is an associate of the Centre.

TABLE 3: SUMMARY OF RESOURCES APPLIED TO ACTIVITIES OF CENTRE (2001/02) ($'000)

	Actual 1999/00	Actual 2000/01	Actual 2001/02	Agreement 2001/02	Cumulative To Date Actual	Cumulative To Date Agreement	Agreement 2002/03	Agreement 2003/04	Agreement 2004/05	Agreement 2005/06	Grand Total
GRAND TOTAL (IN-KIND) FROM TABLE 1 (T1)	5,691	5,071	5,942	5,895	16,704	17,205	5,905	5,790	5,715	5,460	39,574
GRAND TOTAL (CASH EXPENDITURE) FROM TABLE 2 (T3)	3,298	3,322	3,529	5,030	10,149	13,395	5,325	5,350	5,490	5,070	31,384
TOTAL RESOURCES APPLIED TO ACTIVITIES OF CENTRE (T1+T3)	8,989	8,393	9,471	10,925	26,853	30,600	11,230	11,140	11,205	10,530	70,958
ALLOCATION OF TOTAL RESOURCES APPLIED TO ACTIVITIES OF CENTRE BETWEEN HEADS OF EXPENDITURE											
TOTAL SALARIES (CASH AND IN-KIND)	3,918	3,684	4,313	4,787	11,915	13,570	5,225	5,077	5,138	5,014	32,369
TOTAL CAPITAL (CASH AND IN-KIND)	90	42		435	132	1,182	400	485	450	485	1,952
TOTAL OTHER (CASH AND IN-KIND)	4,981	4,667	5,158	5,703	14,806	15,848	5,605	5,578	5,617	5,031	36,637

Notes to the Tables
Financial Year ended 30 June 2002

Note 1: Significant Accounting Policies

The principal accounting policies adopted in preparing the financial information in Tables 1 to 3 for the Cooperative Research Centre for Welded Structures, are stated to assist in a general understanding of this information.

(a) Basis of accounting

The financial information in Tables 1 to 3 have been prepared on the accrual basis of accounting unless otherwise indicated.

(b) Grant incomes

CRC grant funds and other grants are brought to account on an accrual basis.

(d) Participant contributions

Cash
Members' cash contributions are brought to account on an accrual basis.

In-kind
Participants' in-kind contributions are brought to account as received and expenditure incurred. In-kind contributions have been valued on the basis of pre-agreed formulae for each participant based on the participant organisations' operating costs.

(e) Intellectual property

Any intellectual property, as defined in clause 1(1) of the Commonwealth Agreement, dated 15 September 1999, which is generated under the projects currently undertaken is only recognised when it is capable of being separately identified as being of commercial value.

(f) Expenditure commitment

There were no commitments approved and/or entered into prior to 30 June 2002 but not brought to account as actual expenditure in the 2001/02 year.

Note 2: Variations in Heads of Expenditure

The reason for the underexpenditure of $435K in Heads of Expenditure - Capital, during 2001/02 when compared with the Commonwealth Agreement was mainly due to there being no requirement for the acquisition of capital assets beyond that actually incurred.

KPMG

Independent audit report to the parties to the Cooperative Research Centre for Welded Structures

Scope

We have audited the financial information of the Cooperative Research Centre for Welded Structures as set out in Tables 1, 2 and 3 of the Annual Report being the tables showing in-kind and cash contributions for each party to the CRC, and cash expenditure for the year ended 30 June 2002. The parties to the Cooperative Research Centre for Welded Structures are responsible for the preparation and presentation of the financial information. The parties to the Cooperative Research Centre have determined that the accounting policies used and described in Note 1 to the financial information are appropriate to meet the requirements of the Agreement between the Commonwealth of Australia and the parties in relation to The Cooperative Research Centre for Welded Structures ("the Agreement"). The extent to which Accounting Standards and other mandatory professional reporting requirements in Australia have been applied is set out in Note 1. We have conducted an independent audit of the financial information in order to express an opinion on it to the parties to the Cooperative Research Centre for Welded Structures.

The financial information has been prepared for the parties to the Cooperative Research Centre for Welded Structures for the purposes of fulfilling their annual reporting obligations under clause 14.1(f) of the Agreement and for distribution to the Cooperative Research Centres Program, Department of Industry, Science and Resources, representing the Commonwealth of Australia. We disclaim any assumption of responsibility for any reliance on this report or on the financial information to which it relates to any person other than those mentioned above, or for any purpose other than that for which it was prepared.

Our audit has been conducted in accordance with Australian Auditing Standards to provide reasonable assurance as to whether the financial information is free of material misstatement. Our procedures include examination, on a test basis, of evidence supporting the amounts and other disclosures in the financial information, and the evaluation of accounting policies and significant accounting estimates. These procedures have been undertaken to form an opinion as to whether in all material respects, the financial information is presented fairly in accordance with Australian accounting concepts and standards set out in the basis of accounting described in Note 1 to the financial information, and requirements of the Agreement, including Clauses 4 (Contributions), 5(1), 5(2), 5(3) (Application of Grant and Contributions), 9(1), 9(5) (Intellectual Property) and 12(2) (Financial Provisions), so as to present a view of the sources of funding and the application of funding of the Cooperative Research Centre for Welded Structures which is consistent with our understanding of its financial activities during the year and its financial position.

We have not performed any audit procedures upon the estimates or budgets for future periods included in the financial information and therefore, do not express any opinion on them.

The audit opinion expressed in this report has been formed on the above basis.

KPMG

Qualification

Clause 4

Each participant's component of the Researcher's contribution for the year under report has been provided to at least the value committed in the Budget as specified in the Agreement with the exception of the following:

Organisation	Amount committed $'000	Amount provided $'000
In kind contributions		
University of Sydney	300	131
Comweld Group Pty Ltd	100	51
Agility Team Build Pty Ltd	92	35
Woodside Energy Ltd	80	58
OneSteel	80	24
Cash contribution		
Comweld Group Pty ltd	100	50

Clause 5 (2)

The Researcher's allocation of the budgetary resources between Heads of Expenditure has been lower than the allocation in the budget by the greater of $100,000 or 20% without prior approval by the Commonwealth in the following category:

Head of expenditure	Actual expenditure $'000	Budgeted expenditure $'000
Capital	-	435

The decreased capital expenditure resulted as there was no requirement for the acquisition of capital assets during the year.

KPMG

Qualified Audit opinion

In our opinion, except for the effects on the financial information of the matters referred to in the qualification paragraph, the financial information presented in Tables 1, 2 and 3 presents fairly the sources of funding, the application of funding and the financial position of the Cooperative Research Centre for Welded Structures for the year ended 30 June 2002 in accordance with Australian accounting concepts and Accounting Standards set out in the basis of accounting described in Note 1 to the financial information, and the requirements of the Agreement.

KPMG

KPMG

Warwick Shanks
Partner

Place: Wollongong

Date: 22 August 2002

TABLE 4: ALLOCATION OF RESOURCES BETWEEN CATEGORIES OF ACTIVITIES (2001/02)

PROGRAM	RESOURCES USAGE			
	CASH	IN-KIND	STAFF CONTRIBUTION	STAFF FUNDED BY CRC
	$'000	$'000	Person Years	Person Years
Research	2,195	4,762	14	27
Education	252	134		1
Commercialisation and Technology Transfer	447	491	1	3
Administration	635	555	2	5
TOTAL	**3,529**	**5,942**	**17**	**36**

ATTACHMENT A: PERCENTAGE TIME ALLOCATION OF RESEARCH STAFF RESOURCES - IN-KIND CONTRIBUTION for the Financial Year 2001/02

*** Main Activity:**
R - Research;
E - Education;
C - Commercialisation/Business Relations/Technology Transfer;
A - Administration.

**** Sub-program:**
1 Pipeline
2 Joining Equipment and Consumables
3 Power Generation and Petrochemical Industry
4 Mining
5 Building and Construction
6 Health and Safety

Name of Staff	Main Activity*	Total % of Time	% Allocation of Time Spent									
			Research Program							Education Program	Commercialisation Program	CRC Administration
			sub-program**						Total Research			
			1	2	3	4	5	6				
Name of Organisation: University of Wollongong												
Mr B Glass	R	100					100		100			
Mr P Sorrenson	R	100					100		100			
Dr F G DeBoer	R	40	20	10	10				40			
Prof D P Dunne	R	27	4		2		21		27			
Prof C Cook	R	20	10	10					20			
Mr B Lake	R	17					17		17			
A/Prof P Cooper	R	15		5				10	15			
Prof G Wallace	R	10			10				10			
A/Prof A Basu	R	10	10						10			
A/Prof T Chandra	R	10	5				5		10			
Prof H Brown	R	10	10						10			
Dr Z Chen	R	10	5				5		10			
Dr S Gower	R	10	10						10			
Dr T Chee	R	9						9	9			
Dr D Cuiuri	R	7		7					7			
Prof M West	R	5					5		5			
Dr L Dunn	R	5	5						5			
Prof X Dou	R	5		5					5			
Prof P Robinson	A	5										5
Total		**415**	**79**	**37**	**22**		**253**	**19**	**410**			**5**
Name of Organisation: Adelaide University												
Dr G Powell	R	56				43	13		56			
Mr K Meeuwisson	R	51						51	51			
Mr I Brown	R	48	6			1	38	1	46			2
Dr Z Alwahabi	R	7						7	7			
Various	R	17	7				8		15			2
Total		**179**	**13**			**44**	**59**	**59**	**175**			**4**
Name of Organisation: University of Sydney												
Prof G Hancock	R	9					9		9			
A/Prof K Rasmussen	R	7					7		7			
Total		**16**					**16**		**16**			
Name of Organisation: University of Western Australia												
Mr D Pack	R	75	75						75			
Mr D Brooker	R	50					50		50			
Prof B Ronalds	R	40	7				22		29			11
Mr J Tuty	R	25					25		25			
Dr M Fakas	R	24					18		18			6
Ms M Pilotto	R	17					17		17			
Mr T McGrath	R	11										11
Various	R	9	2						2			7
Total		**251**	**84**				**132**		**216**			**35**
Name of Organisation: Commonwealth Scientific and Industrial Research Organisation												
Dr B Bednarz	R	32						32	32			
Dr V Mazur	R	31		31					31			
Dr M Painter	R	9	9						9			
Various	R	15	2	3	6				11			4
Dr N Ahmed	A	17						3	3			14
Dr I Sare	A	12										12
Total		**116**	**11**	**34**	**6**			**35**	**86**			**30**

Budget

Name of Staff	Main Activity*	Total % of Time	% Allocation of Time Spent									
			Research Program							Education Program	Commercialisation Program	CRC Administration
			sub-program**						Total Research			
			1	2	3	4	5	6				
Name of Organisation: Australian Nuclear Science and Technology Organisation												
Mr A B Croker	R	23	4		11				15			8
Mr R Finlay	R	12			12				12			
Various	R	31	20		4			5	29			2
Mr P Stathers	A	4										4
Total		**70**	**24**		**27**			**5**	**56**			**14**
Name of Organisation: Department of Defence, Science and Technology Organisation												
Dr R Phillips	R	13					13		13			
Dr L Davidson	R	11					6		6			5
Mr P Calleja	R	10					10		10			
Dr P Baburamani	R	6					6		6			
Various	R	3					3		3			
Total		**43**					**38**		**38**			**5**
Name of Organisation: Pacific Power												
Mr R Small	R	28			28				28			
Total		**28**			**28**				**28**			
Name of Organisation: The Broken Hill Proprietary Company Limited												
Dr G Bowie	R	27	24						24			3
Dr F Barbaro	R	16	3	1			4		8			8
Mr B Cannon	R	15		5			10		15			
Dr D O'Brien	R	7					7		7			
Various	A	5					1		1			4
Total		**70**	**27**	**6**			**22**		**55**			**15**
Name of Organisation: Welding Technology Institute of Australia												
Mr C Smallbone	C	40									35	5
Various	C	122									106	16
Total		**162**									**141**	**21**
Name of Organisation: Cigweld												
Mr M Pitrun	R	3					3		3			
Mr R Kuebler	A	9										9
Total		**12**					**3**		**3**			**9**
Name of Organisation: Australian Pipeline Industry Association Incorporated												
Mr B Rochford	R	52	52						52			
Various	R	22	18						18			4
Total		**74**	**70**						**70**			**4**
Name of Organisation: Agility Team Build Pty Ltd												
Mr S Humphries	R	6	6						6			
Various	R	5	4						4			1
Total		**11**	**10**						**10**			**1**
Name of Organisation: OneSteel Limited												
Mr H Dagg	R	10					5		5			5
Total		**10**					**5**		**5**			**5**
Name of Organisation: Swinburne University												
A/Prof M Brandt	R	15			15				15			
Various	R	5			5				5			
Total		**20**			**20**				**20**			
Name of Organisation: Industry												
Various	R	103	63		16		24		103			
Total		**103**	**63**		**16**		**24**		**103**			
Grand Total		**1,580**	**381**	**77**	**119**	**44**	**552**	**118**	**1,291**		**141**	**148**

ATTACHMENT B: PERCENTAGE TIME ALLOCATION OF RESEARCH STAFF RESOURCES CRC FUNDED for the Financial Year 2001/02

*** Employing Organisation:**

UOW - University of Wollongong
UOA - University of Adelaide
UOS - University of Sydney
UWA (COGE) - University of Western Australia (COGE)
CSIRO (MST) - CSIRO Manufacturing Science and Technology
ANSTO - Australian Nuclear Science and Technology Organisation
DSTO - Commonwealth Department of Defence (DSTO)
PP - Pacific Power
BHP - The Broken Hill Proprietary Co Ltd
WTIA - Welding Technology Institute of Australia
Cigweld - Comweld Group Pty Ltd
APIA - Australian Pipeline Industry Association Incorporated
TWI - The Welding Institute
Agility - Agility
Woodside - Woodside Energy Limited
OneSteel - OneSteel Limited
IRIS - Swinburne University
CRC-WS (HO) - CRC-WS Head Office

**** Main Activity:**

R - Research;
E - Education;
C - Commercialisation/Business Relations
A - Administration.

***** Sub-program:**

1 Pipeline
2 Joining Equipment and Consumables
3 Power Generation and Petrochemical Industry
4 Mining
5 Building and Construction
6 Health and Safety

Name of Staff	Employing Organisation*	Main Activity**	Total % of Time	% Allocation of Time Spent									
				Research Program							Education Program	Commercialisation Program	CRC Administration
				sub-program***						Total Research			
				1	2	3	4	5	6				
Mr G Dean	UOW	R	100		100					100			
Mr G Slater	UOW	R	100						100	100			
Mr Z Sterjovski	UOW	R	100			100				100			
Dr D Nolan	UOW	R	100	31		13		56		100			
Dr S Nulsen	UOW	R	100	41	59					100			
Dr P Di Pietro	UOW	R	100	77		23				100			
Mr A Alimpijevic	UOW	R	100	100						100			
Prof J Norrish	UOW	R	100	16	44	1		13	10	84	6	10	
Dr S Huang	UOW	R	73			24	3	46		73			
Ms E Budzakoska	UOW	R	67			67				67			
Dr H Wang	UOW	R	65	65						65			
Mr A Nicholson	UOW	R	42			42				42			
Mr B King	UOW	R	33			33				33			
Mr G So	UOW	R	24	24						24			
Mr I Roach	UOW	R	8	8						8			
Various	UOW	R	5		5					5			
Mr A Dunstone	UOA	R	100	100						100			
Mr A McLean	UOA	R	100					100		100			
Prof V Linton	UOA	E	100	5			5	17	11	38	57	5	
Mr R Zettler	UOA	R	50					50		50			
Mr O Lucas	UOA	R	25						25	25			
Dr K Krishnan	UOA	R	19					19		19			
Mr L Mills	UOA	R	17	17						17			
Mr J Hamedi	UOA	R	17					17		17			
Mr D Miller	UOA	R	8					8		8			
Various	UOA	R	18				18			18			
Ms D Nortje	UOS	R	5					5		5			
Various	UOS	R	27					27		27			
Mr L O'Neill	UWA - COGE	R	50					50		50			
Dr G Cole	UWA - COGE	R	50					50		50			
Mr R Pinna	UWA - COGE	R	42					42		42			
A/Prof T Edwards	UWA - COGE	R	9	9						9			
Mr T Gordon	CSIRO - MST	R	100						100	100			
Dr N Alam	CSIRO - MST	R	33			33				33			
Mr M Fanning	CSIRO - MST	R	15		11				4	15			
Mr T Doan	CSIRO - MST	R	14		14					14			
Mr L Jarvis	CSIRO - MST	R	11		7				4	11			
Various	CSIRO - MST	R	48	17	5	3			23	48			
Mr M Law	ANSTO	R	69	54		15				69			
Mr P Stathers	ANSTO	R	15	8				7		15			
Mr K Thorogood	ANSTO	R	10			10				10			
Mr S Humphries	ANSTO	R	9		2	7				9			
Dr H Li	ANSTO	R	3			3				3			
Various	ANSTO	R	3	2		1				3			

ATTACHMENT B: PERCENTAGE TIME ALLOCATION OF RESEARCH STAFF RESOURCES CRC FUNDED for the Financial Year 2001/02 *continued*

Name of Staff	Employing Organisation*	Main Activity**	Total % of Time	% Allocation of Time Spent									
				Research Program							Education Program	Commercialisation Program	CRC Administration
				sub-program***						Total Research			
				1	2	3	4	5	6				
Mr D Franke	Pacific Power	R	28			28				28			
Mr A Chapman	Pacific Power	R	28			28				28			
Mr R Midgley	Pacific Power	R	7			7				7			
Mr B Sherlock	Pacific Power	R	7			7				7			
Various	Pacific Power	R	14			14				14			
Various	BHP - FP	R	22	20				2		22			
Mr A Forbes	WTIA	C	100									100	
Ms A Rorke	WTIA	C	50									50	
Mr S Ambrose	WTIA	C	50									50	
Mr L Rosenbrock	WTIA	R	24			24				24			
Dr Y Durandet	IRIS	R	7			7				7			
Various	IRIS	R	15			15				15			
Dr K Enever	CRC-WS (HO)	R	70										70
Mr M Conyngham	CRC-WS (HO)	E	60								60		
Dr C Chipperfield	CRC-WS (HO)	A	100										100
Mr S Suntheraraj	CRC-WS (HO)	A	100										100
Total			**2,766**	**594**	**247**	**505**	**26**	**509**	**277**	**2,158**	**123**	**215**	**270**

ATTACHMENT C: SUMMARY OF RESEARCH STAFF RESOURCES CONTRIBUTION IN PERSON YEARS for the Financial Year 2001/02

(100% = 1 Person Year)

***Sub-program:**
1 Pipeline
2 Joining Equipment and Consumables
3 Power Generation and Petrochemical Industry
4 Mining
5 Building and Construction
6 Health and Safety

	Total Equivalent Person Years	Person Years Spent									
		Research Program							Education Program	Commercialisation Program	CRC Administration
		sub-program*						Total Research			
		1	2	3	4	5	6				
Total Contributed by the Participants	15.8	3.8	0.8	1.2	0.4	5.5	1.2	12.9		1.4	1.5
Total Funded by CRC	27.6	5.9	2.5	5.0	0.3	5.1	2.8	21.6	1.2	2.1	2.7
Grand Total	**43.4**	**9.7**	**3.3**	**6.2**	**0.7**	**10.6**	**4.0**	**34.5**	**1.2**	**3.5**	**4.2**
Proportion of Total Professional Staff Resources in each activity	100%	22%	8%	14%	2%	24%	9%	79%	3%	8%	10%

ATTACHMENT D: SUPPORT STAFF RESOURCES for the Financial Year 2001/02

(100% = 1 Person Year)

(1) CONTRIBUTED	
Organisation	Number of Staff Person Years
University of Wollongong	1.2
Adelaide University	0.2
University of Sydney	0.0
The University of Western Australia	0.0
Commonwealth Scientific and Industrial Research Organisation	0.5
Australian Nuclear Science and Technology Organisation	0.0
Commonwealth Department of Defence, Science and Technology Organisation	0.0
Pacific Power	0.0
The Broken Hill Proprietary Co Ltd	0.3
Welding Technology Institute of Australia	0.0
Comweld Group Pty Ltd (Cigweld)	0.0
Australian Pipeline Industry Association Incorporated	0.0
The Welding Institute (TWI)	0.3
Agility Team Build Pty Ltd	0.0
Woodside Energy Limited	0.0
OneSteel Limited	0.0
Swinburne University	0.0
Total	**2.5**

(2) CRC FUNDED	
Organisation	Number of Staff Person Years
University of Wollongong	1.5
Adelaide University	0.2
University of Sydney	0.8
The University of Western Australia	0.0
Commonwealth Scientific and Industrial Research Organisation	1.7
Australian Nuclear Science and Technology Organisation	0.4
Commonwealth Department of Defence, Science and Technology Organisation	0.0
Pacific Power	0.0
The Broken Hill Proprietary Co Ltd	0.7
Welding Technology Institute of Australia	1.0
Comweld Group Pty Ltd (Cigweld)	0.0
Australian Pipeline Industry Association Incorporated	0.0
The Welding Institute (TWI)	0.0
Agility Team Build Pty Ltd	0.0
Woodside Energy Limited	0.0
OneSteel Limited	0.0
Swinburne University	0.2
CRC-WS Head Office	2.2
Total	**8.7**

CRC FOR WELDED STRUCTURES LIMITED
(ABN 88 058 890 412)
(LIMITED BY GUARANTEE)

FINANCIAL REPORT

FOR THE YEAR ENDED
30 JUNE 2002

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DIRECTORS' REPORT
FOR THE YEAR ENDED 30 JUNE 2002

Your directors present their report on the Company for the year ended 30 June 2002.

1. Directors

The following persons were Directors of the CRC for Welded Structures Limited during the whole of the financial year and up to the date of this report:

	Date of Appointment
• Mr Rodney Harold Keller	4 October 2001
• Dr Colin George Chipperfield	2 December 1999
• Dr Ian Richard Sare	25 August 1995
• Mr Christopher Smallbone	25 August 1995
• Mr James Geoffrey Williams	10 May 1996
• Professor Peter Mather Robinson	14 October 1998
• Mr Richard Ernst Kuebler	26 August 1999
• Professor Beverley Frances Ronalds	26 August 1999
• Mr Neil Cain	4 May 2000
• Mr Robert Male	4 May 2000
• Prof Judy Agnes Raper	29 June 2001

The following persons were Directors from the date of their appointment to the date of this report:

• Mr James Lionel White	21 August 2001
• Mr Ian Hamilton Haddow	20 December 2001
• Dr George Andrew Collins	24 January 2002
• Mr Barry Francis Finlay	20 February 2002
• Dr Richard Brian Oldland	12 June 2002
• Mr Alistair McFarlane	22 August 2002

Dr Donald Gatherer Williams was Chairman from 22 February 1993 until his death on 6 August 2001. Mr Rodney Harold Keller was a Director from 26 August 1999 to 3 October 2001 and was appointed Chairman of the Company on 4 October 2001. Messrs Cecil Raymond Stubbs, Thomas James Bryant and Robert Smith were Directors from the beginning of the financial year to 31 August 2001, 15 February 2002 and 3 June 2002, respectively. Drs Adam Jostsons and Robert John were Directors from the beginning of the financial year until their resignation on 14 December 2001 and 22 August 2002, respectively.

2. Principal continuing activity

The principal activity of the Company consisted of promoting and establishing co-operative research and development programs, providing training facilities and promoting technology transfer and communication in the field of welded structures.

3. Results

The net result from the ordinary activities of the Company for the year ended 30 June 2002 was a profit of $123,117 (2001: profit of $241,318).

4. Review of operations

The activities of the Company were mainly in the following areas:

- cooperative arrangements with industry, inter-partner collaboration and international collaboration;
- research and development and technology transfer; and
- education and training.

5. Significant changes in the state of affairs

There have been no major changes to the structure of the Company during the year ended 30 June 2002.

6. Events subsequent to balance date

Since the end of the financial year, the directors are not aware of any matters or circumstance not otherwise dealt with in the report that has significantly affected, or may significantly affect:

(a) the Company's operations in future financial years; or

(b) the results of those operations in future financial years; or

(c) the Company's state of affairs in future financial years.

7. Likely developments

The Company's distance learning program for the education of welding engineers has been licenced to Cranfield University in the UK. This licence should provide significant revenue flows to the Company during the financial year 2002/03. Additional international licences will also be progressed during the next financial year.

The commercialisation of further Company intellectual property is expected in the ensuing financial year, including the sale of the Company's "Hot Tap" software, licencing of the High Current TIG process and, commercialisation of the "Phoenix" technology through the Company's associate company JoinTechnology Pty Ltd.

8. Directors' benefits

No director of the Company has, during the year ended 30 June 2002, received or has become entitled to receive a benefit (other than a benefit included in the total amount of emoluments received or due and receivable by directors shown in the accounts) by reason of a contract made by the Company with the director or with a firm of which the director is a member, or with an entity in which the director has a substantial financial interest.

9. Information on directors

Director	Qualifications and Experience	Special Responsibilities
Mr R H Keller	BE (Mech), FIEAust Non-Executive Chairman GasNet Australia Trust	Director
Dr C G Chipperfield	MA, PhD Previously Executive Director Australian Maritime Engineering Cooperative Research Centre	Chief Executive Officer
Dr I R Sare	BSc, PhD, FTSE, FIEAust, FIM, FAICD Chief of Division CSIRO Manufacturing Science and Technology	Director
Mr C Smallbone	MSc, FIEAust, CPEng, CEng, HonFWTIA Executive Director Welding Technology Institute of Australia	Director
Mr J G Williams	BSc Manager Metallurgical Technology BHP Steel	Director

Director	Qualifications and Experience	Special Responsibilities
Prof P M Robinson	AM, BSc, PhD, DSc, FTSE, FIEAust, CEng Corporate Advisor (Technology and Innovation) University of Wollongong	Director
Mr R E Kuebler	BEng Senior Development Engineer Comweld Group Pty Ltd	Director
Prof B F Ronalds	BE, MSc DIC, PhD, FTSE, FIEAust, FICE Director and Woodside Professor The Centre for Oil and Gas Engineering The University of Western Australia	Director
Mr N R Cain	DipEng (Civil), MIEAust, CPEng General Manager Commercial Agility	Director
Mr R Male	BE (Hons), MS Team Leader Facilities Engineering Woodside Energy Limited	Director
Prof J A Raper	BE (Hons), PhD, FIEAust, FIChemE, CPEng Dean of Engineering University of Sydney	Director
Mr J L White	BAppSc (Metallurgy), CPEng Vice President, Technology & Environment OneSteel OneSteel Limited	Director
Mr I H Haddow	BE (Hons), Grad Diploma Admin (CCAE) General Manager Technical Australian Pipeline Trust	Director
Dr G A Collins	BSc (Hons) PhD, MAIP Director Materials Australian Nuclear Science & Technology Organisation	Director
Mr B F Finlay	BE, M.Eng.Sc., MBA, MIE Aust, M IEEE General Manager Technical Services Pacific Power International	Director
Dr R B Oldland	BSc (Hons), MSc, PhD Director FTS Technology Services	Director
Mr A McFarlane	MBA (adv), B.Ag.Sc, AAPI Business Development Manager EMCS and Professional Services Faculties University of Adelaide	Director

10. Indemnification and insurance of officers

During the year, a premium was paid in respect of a contract insuring Directors and officers of the Company against liability. In accordance with normal commercial practice, disclosure of the total premium paid under, and the nature of liabilities covered by, the insurance contract is prohibited by a confidentiality clause in the contract. No insurance cover has been provided for the benefit of the auditors of the Company.

11. Directors' meetings

The number of directors' meetings held during the year ended 30 June 2002 and the number of meetings attended by each director were:

Director	No. of Board Meetings	
	A	B
Mr R H Keller	3	4
Dr C Chipperfield	4	4
Dr I R Sare	4	4
Mr C Smallbone	4	4
Mr J G Williams	4	4
Prof P M Robinson	2	4
Mr R E Kuebler	3	4
Prof B F Ronalds	3	4
Mr N Cain	2	4
Mr R Male	1	4
Prof J Raper	2	4
Mr J L White	2	4
Mr I H Haddow	2	2
Dr G A Collins	2	2
Mr B F Finlay	1	2
Dr R B Oldland	1	1
Mr C R Stubbs (resigned 31 August 2001)	1	1
Mr T J Bryant (resigned 15 February 2002)	0	2
Dr A Jostsons (resigned 14 December 2001)	2	2
Mr R Smith (resigned 3 June 2002)	3	3
Dr R John (resigned 22 August 2002)	0	4
Mr R Small (Alternate for Mr T Bryant)	1	2
Mr R Small (Alternate for Mr B Finlay)	1	2
Mr L Fletcher (Alternate for Dr R John)	2	4
Prof M Barber (Alternate for Prof B Ronalds)	1	4

A - Number of meetings attended
B - Number of meetings held during the time the director held office during the year

During the year ended 30 June 2002, the audit committee met once before being replaced by the Executive Committee which also assumed the functions of the audit committee. The number of audit committee and executive committee meetings held and attended by each director were:

Director	Audit Committee Meetings		Executive Committee Meetings	
	A	B	A	B
Mr R H Keller	1	1	2	2
Mr C R Stubbs	1	1		
Dr C Chipperfield			2	2
Dr I R Sare			1	2
Mr C Smallbone			2	2
Prof P M Robinson	1	1	2	2
Mr I F Haddow			2	2
Dr R B Oldland			2	2

A - Number of meetings attended
B - Number of meetings held during the time the director held office during the year

12. Directors' interests in contracts

No material contracts involving directors' interests were entered into during the period or existed at the end of the period.

This report is made in accordance with a resolution of the directors.

Director .....

Director .....

Date: 22 August 2002
Wollongong, New South Wales, Australia

STATEMENT OF FINANCIAL PERFORMANCE
FOR THE YEAR ENDED 30 JUNE 2002

	Notes	2002 $	2001 $
Revenue from ordinary activities	2	8,950,620	8,473,957
Expenses from ordinary activities	3	(8,827,503)	(8,232,639)
Share of net profits from associate company	4	0	0
Operating profit		123,117	241,318
Income Tax attributable to operating profit	1 (i)	-	-
Operating profit after income tax		**123,117**	**241,318**

The statement of financial performance should be read in conjunction with the accompanying notes set out on pages 59 to 66.

STATEMENT OF FINANCIAL POSITION AS AT 30 JUNE 2002

	Notes	2002 $	2001 $
CURRENT ASSETS			
Cash assets	5	1,161,024	1,049,953
Receivables	6	128,317	318,201
TOTAL CURRENT ASSETS		**1,289,341**	**1,368,154**
NON-CURRENT ASSETS			
Investments accounted for using the equity method	7	2	-
Property, plant and equipment	8	48,620	103,737
TOTAL NON-CURRENT ASSETS		**48,622**	**103,737**
TOTAL ASSETS		**1,337,963**	**1,471,891**
CURRENT LIABILITIES			
Payables	9	522,463	784,304
Provisions	10	29,266	15,928
Other	11	401,200	409,742
TOTAL CURRENT LIABILITIES		**952,929**	**1,209,974**
TOTAL LIABILITIES		**952,929**	**1,209,974**
NET ASSETS		**385,034**	**261,917**
EQUITY			
Retained Profits	12	385,034	261,917
TOTAL EQUITY		**385,034**	**261,917**

The above statement of financial position should be read in conjunction with the accompanying notes set out on pages 59 to 66.

STATEMENT OF CASH FLOWS
FOR THE YEAR ENDED 30 JUNE 2002

	Notes	2002 $	2001 $
Cash flows from operating activities			
Receipts from government and participants		4,974,467	4,153,342
Payments to suppliers and employees		(4,893,671)	(3,725,199)
Interest received		44,523	41,873
Net cash provided by operating activities	20	125,319	470,016
Cash flows from investing activities			
Payment for property, plant and equipment		(14,246)	(32,221)
Proceeds from disposal of property, plant and equipment		-	10
Investment in Associate Company		(2)	-
Net cash used in investing activities		(14,248)	(32,211)
Net increase in cash held		111,071	437,805
Cash at the beginning of the financial year		1,049,953	612,148
CASH AT THE END OF THE FINANCIAL YEAR	5	1,161,024	1,049,953

The above statement of cash flows should be read in conjunction with the accompanying notes set out on pages 59 to 66.

NOTES TO THE FINANCIAL STATEMENTS FOR THE YEAR ENDED 30 JUNE 2002

1) Summary of significant accounting policies

This general purpose financial report has been prepared in accordance with Accounting Standards, other authoritative pronouncements of the Australian Accounting Standards Board, Urgent Issues Group Consensus Views and the Corporations Law.

The principal accounting policies adopted in preparing the financial statements of the Company, the CRC for Welded Structures Limited, are stated to assist in a general understanding of these financial statements. These policies have been consistently applied by the Company except as otherwise indicated.

The financial report is prepared in accordance with the historical cost convention and except where stated, does not take into account current valuations of non-current assets. The Company has not adopted a policy of revaluing its non-current assets on a regular basis. Unless otherwise stated, the accounting policies adopted are consistent with those of the previous year.

(a) Associates
Associates are those entities over which the Company exercises significant influence and which are not intended for sale in the near future.

In the financial statements, investments in associates are accounted for using equity accounting principles. Investments in associates are carried at the lower of the equity accounted amount and recoverable amount. The Company's equity accounted share of the associate's net profit or loss is recognised in the statement of financial performance from the date significant influence commences until the date significant influence ceases.

(b) Depreciation of property, plant and equipment
Depreciation is calculated on a straight line basis to write off the net or revalued amount of each item of property, plant and equipment (excluding land) over its expected useful life to the Company. Estimates of remaining useful lives are made on a regular basis for all assets.

The expected useful lives are as follows:

Plant and equipment, furniture and fittings	3 - 10 years
Motor vehicles	4 years

Profits and losses on disposal of property, plant and equipment are taken into account in determining the results for the year.

(c) Non-current assets constructed by the Company
The cost of non-current assets constructed by the Company includes the cost of all materials used in construction, direct labour on the project, and an appropriate proportion of variable and fixed overhead.

(d) Research and development expenditure
Research and development costs are recognised as an expense in the period in which they are incurred. Costs incurred on research and development projects are deferred to future periods to the extent that such costs are expected by the directors to be recoverable beyond any reasonable doubt against future revenues.

(e) Operating revenue
Cash contributions from the Commonwealth Government and Participants of the Company represent operating revenue when expended on research projects.

In-kind contributions from Participants are brought to account as revenue received and expenditure incurred. In-kind contributions have been valued on the basis of pre-agreed formulae which represent participant organisations' underlying operating costs.

Other revenue includes interest income on short term investments.

(f) Receivables
Collectibility of trade debtors is reviewed on an ongoing basis. Debts which are known to be uncollectible are written off in the period they are identified. A provision for doubtful debts is raised when some doubt as to collection exists.

NOTES TO THE FINANCIAL STATEMENTS FOR THE YEAR ENDED 30 JUNE 2002 *continued*

(g) Trade and other creditors

These amounts represent liabilities for goods and services provided to the Company prior to the end of the financial year and which are unpaid. These amounts are unsecured and are usually paid within 30 days of recognition.

(h) Employee entitlements

(i) Wages and salaries, annual leave and sick leave

Liabilities for wages and salaries and annual leave are recognised, and are measured as the amount unpaid at the reporting date at current pay rates in respect of employees' services up to that date.

No provision has been made for sick leave as all sick leave is non-vesting and the average sick leave taken by employees is less than the annual entitlement for sick leave.

(ii) Long service leave

A liability for long service leave is recognised and is measured as the present value of expected future payments to be made in respect of services provided by employees up to reporting date. Consideration is given to expected future wage and salary levels, experience of employee departures and periods of service.

(iii) Superannuation

Contributions to employee superannuation funds are charged as expense as the contributions are paid or become payable.

(h) Income tax

The Company is exempt from income tax under Section 23 (e) of the Income Tax Assessment Act (1936).

(i) Cash flows

For the purposes of the Statement of Cash Flows, cash includes cash on hand, deposits held at call with banks and investments in money market instruments, net of overdrafts.

NOTES TO THE FINANCIAL STATEMENTS FOR THE YEAR ENDED 30 JUNE 2002 *continued*

	2002 $	2001 $
2) Revenue from ordinary activities		
Revenue from operating activities:		
Contribution from government and participants - cash	3,511,096	3,356,330
Contribution from participants - in-kind	5,345,201	5,071,469
	8,856,297	8,427,799
Revenue from outside the operating activities:		
Course fees	49,800	4,285
Interest	44,523	41,873
	8,950,620	8,473,957
3) Operating profit/(loss)		
(a) Expenses from ordinary activities		
Cash		
Research	2,148,544	1,846,425
Education	251,961	286,377
Commercialisation/Technology Transfer	447,148	381,734
Administration	634,649	646,634
In-kind		
Research	4,165,864	3,849,001
Education	133,940	156,943
Commercialisation/Technology Transfer	490,629	536,950
Administration	554,768	528,575
Total expenses from ordinary activities	8,827,503	8,232,639
(b) Net gains and expenses		
Profit from ordinary activities before income tax expense includes the following specific net gains and expenses:		
Net gains		
Net gain on disposal of plant and equipment	-	10
Expenses		
Depreciation:		
Plant and equipment	51,228	53,175
Motor vehicles	18,135	18,114
Research expenditure		
Cash	2,148,544	1,816,124
In-kind	4,165,865	3,849,001
Other expenditure		
In-kind	0	0
Employee entitlements	67,539	66,245

NOTES TO THE FINANCIAL STATEMENTS FOR THE YEAR ENDED 30 JUNE 2002 *continued*

	2002 $	2001 $
4) Investments accounted for using the equity method		
Share of net results in associate company accounted for using the equity method included in the statement of financial performance	0	-

Details of investment in the associate company are as follows:

Name of Company	Principal Activity	Balance Date	Ordinary Share Ownership Interest	Investment Carrying Amount	
JoinTechnology Pty Ltd	Manufacturing	30 June	100%	2	-

JoinTechnology Pty Ltd (the associate) was incorporated on 17 December 2001 pursuant to an agreement between the Company and the Commonwealth Scientific and Industry Research Organisation (CSIRO). The board of the associate is constituted by two directors, one nominated by each of the two organisations. The agreement between the two organisations provides CSIRO with the option to acquire one of the two ordinary shares in the Company and the right to 50% of the net revenues generated by the associate. Since the Company has a significant influence over but not a controlling interest in the associate, the investment in the associate is accounted for using the equity method.

5) Cash assets		
Cash on hand	200	200
Cash at bank*	652,077	848,619
Deposits at call**	508,747	201,134
	1,161,024	1,049,953

*Cash at bank is credited with interest at rates ranging from 2% to 3%.
**Deposits at call bear fixed interest rates at 4.5%.

6) Receivables		
Trade debtors	127,817	317,701
Prepayments	500	500
	128,317	318,201

7) Investments accounted for using the equity method		
Associate		
Current assets	39,473	-
Liabilities	39,471	-
Net assets - equity adjusted	2	-

NOTES TO THE FINANCIAL STATEMENTS FOR THE YEAR ENDED 30 JUNE 2001 *continued*

	2002 $	2001 $
8) Property, plant and equipment		
Plant & equipment, furniture & fittings at cost	229,518	230,506
Less: accumulated depreciation	211,281	175,286
Written-down value	18,237	55,220
Motor vehicles at cost	72,538	72,538
Less: accumulated depreciation	42,155	24,021
Written-down value	30,383	48,517
Total plant & equipment	302,056	303,044
Less: accumulated depreciation	253,436	199,307
Written-down value	48,620	103,737
Reconciliations		
Reconciliations of the carrying amounts for each class of property, plant and equipment are set out below.		
Plant & equipment, furniture & fitting		
Carrying amount at beginning of year	55,220	106,527
Additions	14,246	1,868
Disposals		
Depreciation	(51,229)	(53,175)
Carrying amount at end of year	18,237	55,220
Motor vehicles		
Carrying amount at beginning of year	48,517	36,278
Additions	-	30,353
Disposals		
Depreciation	(18,134)	(18,114)
Carrying amount at end of year	30,383	48,517
9) Payables		
Trade creditors and accruals	522,463	784,304
10) Provisions		
Employee entitlements	29,266	15,928
11) Other		
Income received in advance	401,200	409,742
12) Total equity reconciliations		
Total equity at beginning of year	261,917	20,599
Total changes in interest in equity recognised in statement of financial performance	123,117	241,318
Total equity at end of year	385,034	261,917

NOTES TO THE FINANCIAL STATEMENTS FOR THE YEAR ENDED 30 JUNE 2001 *continued*

13) Contributions by members

Contributions by members during the years:

	2002		2001	
	Cash $	In-kind $	Cash $	In-kind $
University of Wollongong	50,000	1,481,929	50,000	1,346,998
The University of Adelaide	50,000	791,199	50,000	666,034
The University of Sydney	50,000	131,363	50,000	212,597
The University of Western Australia	25,000	549,082	25,000	598,727
CSIRO Manufacturing Science and Technology	50,000	620,118	50,000	481,196
Australian Nuclear Science and Technology Organisation	50,000	277,437	50,000	333,411
Commonwealth Department of Defence (DSTO)	35,000	147,400	25,000	77,883
Pacific Power	50,000	128,165	50,000	100,247
Broken Hill Proprietary Company Limited	115,000	324,380	165,000	301,745
Welding Technology Institute of Australia	5,000	450,477		498,262
Comweld Group Pty Ltd (Cigweld)	50,000	50,752	100,000	100,917
Australian Pipeline Industry Association Incorporated	30,000	100,978	30,000	101,181
The Welding Institute		108,004		103,100
Agility Team Build Pty Ltd	64,000	34,611	64,000	93,000
Woodside Energy Limited	80,000	57,756	80,000	31,171
OneSteel	100,000	24,248	7,500	25,000
	804,000	5,277,899	796,500	5,071,469

14) Members' guarantee

The Company is a public company limited by guarantee. If the Company is wound up, the Memorandum of Association state that each Member is required to contribute a maximum of $100 towards meeting any outstanding obligations of the Company. At 30 June 2002, the number of Members was 15.

15) Remuneration of directors

Income paid or payable, or otherwise made available, to directors by the Company or related parties in connection with the management of affairs of the Company:

	2002 $	2001 $
from the Company	179,852	175,336

The number of directors of the Company whose total income from the Company or related parties, was within the specified bands are as follows:

$ Nil	to	$ 9,999	23	15
$ 10,000	to	$ 19,999	1	1
$140,000	to	$149,999	-	1
$150,000	to	$159,999	1	-

NOTES TO THE FINANCIAL STATEMENTS FOR THE YEAR ENDED 30 JUNE 2001 *continued*

	2002 $	2001 $
16) Remuneration of auditors		
Remuneration for the audit of the financial reports of the company	10,000	9,500

17) Commitments for expenditure

As at the date of this report, the directors are not aware of any commitments in respect of expenditure as at the balance date.

18) Related parties

(a) Directors
The names of persons who were directors of the CRC for Welded Structures Limited at any time during the financial year are as follows:

Mr R H Keller, Dr C G Chipperfield; Dr I R Sare; Mr C Smallbone; Mr J G Williams; Professor P M Robinson; Mr R E Kuebler; Professor B Ronalds; Mr N Cain; Mr R Male; Professor J A Raper; and Mr J L White.

In addition, Dr D G Williams held office as Chairman until his death on 6 August 2001. Messrs C R Stubbs, T J Bryant and R Smith were directors from the beginning of the financial year until their resignation on 31 August 2001, 15 February 2002 and 3 June 2002 respectively. Drs A Jostsons and R John were directors from the beginning of the financial year until their resignation on 14 December 2001 and 22 August 2002 respectively. Messrs I H Haddow and B F Finlay were appointed directors on 20 December 2001 and 20 February 2002, respectively. Drs G A Collins and R B Oldland were appointed directors on 24 January 2002 and 12 June 2002, respectively.

(b) Remuneration and retirement benefits
Information on remuneration and retirement benefits of directors of the Company is disclosed in Note 15 of the accounts. There were no retirement benefits paid to the directors of the Company by the Company or related parties in connection with their retirement.

The Participants are not considered to be related parties as defined in Accounting Standard AASB 1017. No one Participant is in a position to control or significantly influence either, or both, of the financial or operating policies of the Company. Furthermore, Members of the Board are not in a position to exercise control or significant influence over their respective entities.

19) Segment information

The activities of the Company for the year ended 30 June 2002 were predominantly in activities involved in the total product life cycle engineering of welded structures, promoting and establishing co-operative research and development programmes, providing training facilities and promoting technology transfer and commercialisation within Australia.

20) Reconciliation of operating profit/(loss) after income tax to net cash flows from operating activities

	2002 $	2001 $
Operating profit	123,117	241,318
Depreciation	69,363	71,289
(Gain)/Loss on sale of plant and equipment	-	(10)
	192,480	312,597
Change in operating assets and liabilities		
(Increase)/Decrease in current assets - other	189,884	(219,145)
Increase/(Decrease) in current liabilities	(257,045)	381,331
(Decrease)/Increase in non-current liabilities	-	(4,767)
Net cash provided by operating activities	125,319	470,016

21) Financial Instruments

(i) Credit risk exposure
The credit risk on financial assets of the Company which have been recognised on the balance sheet is generally the carrying amount, net of any provisions for doubtful debts.

(ii) Interest rate risk exposure
The only interest bearing financial asset is cash. All other financial assets/liabilities are non-interest bearing.

(iii) Net fair value of financial assets and liabilities
The net fair value of cash equivalents and non-interest bearing monetary financial assets and financial liabilities of the Company approximate their carrying value.

DIRECTORS' DECLARATION
FOR THE YEAR ENDED 30 JUNE 2002

In the opinion of the directors of the CRC for Welded Structures Limited:

(a) the financial statements and notes, set out on pages 56 to 66, are in accordance with the Corporations Act 2001, including:

(i) giving a true and fair view of the financial position of the Company as at 30 June 2002 and of their performance, as represented by the results of their operations and their cash flows, for the year ended on that date: and

(ii) complying with Accounting Standards and the Corporations Regulations 2001; and

(b) there are reasonable grounds to believe that the Company will be able to pay its debts as and when they become due and payable.

Signed in accordance with a resolution of the directors.

Director .....

Director .....

Date: 22 August 2002

Wollongong, New South Wales, Australia

KPMG

Independent audit report to the members of CRC for Welded Structures Limited

Scope

We have audited the financial report of CRC for Welded Structures Limited for the financial year ended 30 June 2002 consisting of the statement of financial performance, statement of financial position, statement of cash flows, accompanying notes, and the directors' declaration set out on pages 56 to 67. The company's directors are responsible for the financial report. We have conducted an independent audit of this financial report in order to express an opinion on it to the members of the company.

Our audit has been conducted in accordance with Australian Auditing Standards to provide reasonable assurance whether the financial report is free of material misstatement. Our procedures included examination, on a test basis, of evidence supporting the amounts and other disclosures in the financial report, and the evaluation of accounting policies and significant accounting estimates. These procedures have been undertaken to form an opinion whether, in all material respects, the financial report is presented fairly in accordance with Accounting Standards and other mandatory professional reporting requirements in Australia and statutory requirements so as to present a view which is consistent with our understanding of the company's financial position, and performance as represented by the results of its operations and its cash flows.

The audit opinion expressed in this report has been formed on the above basis.

Audit opinion

In our opinion, the financial report of CRC for Welded Structures Limited is in accordance with:

(a) the Corporations Act 2001, including:

(i) giving a true and fair view of the company's financial position as at 30 June 2002 and of its performance for the year ended on that date; and

(ii) complying with Accounting Standards and the Corporations Regulations 2001; and

(b) other mandatory professional reporting requirements.

KPMG

KPMG
Chartered Accountants

Warwick Shanks
Partner
Dated at Wollongong this 22nd day of August 2002.

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