DEVELOPMENT OF A DESIGN HANDBOOK ON STRESS-CORROSION CRACKING

Roger W. Staehle, et al
Ohio State University

Prepared for:
Office of Naval Research
Advanced Research Projects Agency

September 1974

DISTRIBUTED BY:
NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
**Development of a Design Handbook on Stress-Corrosion Cracking**

Roger W. Staehle  Markus O. Speidel

**Abstract**

Significant progress has been made in compiling the data base from which the contents of the handbook on stress corrosion cracking will be extracted.

In a first effort, extensive computerized literature searches were done. A second effort to collect available information on stress corrosion cracking was undertaken by contacting in writing more than two hundred recognized specialists active in this field. Early results of these efforts are presented.
Development of a Design Handbook
On Stress-Corrosion Cracking

I. Progress to date
   a. Computerized literature search.
      Significant progress has been made in compiling the data base from which
      the contents of the handbook will be extracted. Mostly in cooperation with
      the Battelle Columbus Laboratories computerized literature searches were
      made with the following data bases:
      1. DDC (Defence Documentation Center)
      2. MCIC (Metals and Ceramic Information Center)
      3. AEC (Atomic Energy Commission)
      4. CDA (Copper Development Association)
      5. NASA (National Aeronautics and Space Administration)
      6. Lockheed Information Retrieval Service
      7. MIC (Mechanized Information Center - OSU Libraries)
      These literature searches all yielded several hundred (some more than a
      thousand) hits on papers and documents concerning stress corrosion cracking,
      corrosion fatigue, hydrogen embrittlement, and liquid metal embrittlement.
      The most relevant papers and documents were selected and ordered. More than
      50 percent of the publications so identified are already assembled at O.S.U.
   b. Letters to stress corrosion specialists.
      A second effort to collect available information on stress corrosion
      cracking and corrosion fatigue was undertaken by contacting in writing more
      than two hundred recognized specialists active in the fields of stress corrosion
      and corrosion fatigue. The letters that were sent to these specialists outlined
      the project, asked for the contribution of information, both published and
      unpublished, and contained a questionnaire for convenient return. A specimen
of the letters that were sent out is attached as Appendix I. To date, about 50 questionnaires have been returned, with more than 90% of them pledging information in the form of papers, reports, failure statistics, and failure analysis concerned with stress corrosion and corrosion fatigue. Already, over one thousand recent reports and papers on stress corrosion and corrosion fatigue have been compiled. The names of those specialists contacted so far are given in Appendix II. The letters sent out had two purposes:

1. solicit contributions to the handbook
2. generate publicity for the handbook

The very high percentage of pledges to contribute information to the handbook on the returned questionnaires gives us confidence that we will be successful on the first account.

The second objective was to generate publicity. We have achieved this objective and acclaim as well. Many specialists contacted have not only returned their questionnaires with promises to contribute but have also sent letters and remarks indicating what they thought of the ARPA handbook project on stress corrosion cracking. Appendix III gives a collection of such remarks.

II. Work Scheduled for Next Reporting Period

The major effort will consist in organizing and studying the information which was compiled, and extracting data from it for the handbook sections on individual alloy systems.

Parallel to the digestion of the information already received, we will keep up our effort to obtain further relevant reports on stress corrosion and corrosion fatigue. This will mainly be done by following up on the returned questionnaires. In a small number of cases, personal visits to laboratories generating stress corrosion and corrosion fatigue data will be necessary.
Appendix I. Letter sent to stress corrosion specialists

THE OHIO STATE UNIVERSITY

Subject: Handbook of Stress Corrosion Cracking and Corrosion Fatigue of Metallic Materials

Dear

We are preparing a comprehensive handbook on stress corrosion cracking and corrosion fatigue of metallic materials. We are soliciting your cooperation in this endeavor specifically in:

1. Reviewing draft chapters as they are prepared

2. Helping us to assure that our treatment is as thorough as possible with respect to including previously unpublished information from your organization

This handbook is a major cooperative effort among government agencies, universities, and industries. The Advanced Research Projects Agency (ARPA) is sponsoring this program at Ohio State with the objective of focusing and synthesizing the widely scattered literature so that it can be used effectively and reliably by the design and materials communities. The program is for three years and has sufficient funding to permit a proper analysis and presentation of the data. We have already received commitments from some major alloy producers and users to contribute their research results and experience with failed components.

In order to assure the usefulness and quality of the handbook the following specific associated programs are underway:

1. A steering committee headed by H. W. Paxton, Director of Research at Carnegie-Mellon University, has been formed to provide guidance in the preparation and publication of the final volume. The members of this committee are primarily designers who represent the major segments of industry.

2. At Battelle Memorial Institute the Corrosion Division, under the direction of W. K. Boyd, is acquiring and evaluating published literature.
3. A separate “missionary” volume of about 250 pages is being prepared by Dr. B. F. Brown of American University. The purpose of this volume is to describe the essence of the problem in a readily accessible and digestible form.

We intend to make this handbook as comprehensive as possible. We plan to collect and analyze all the presently available information concerning stress corrosion (including hydrogen embrittlement) and corrosion fatigue of the technologically important alloy systems. The results of this effort will be presented in a way which is readily understood by the design engineer. The emphasis is on presentation of data rather than theories. Specifically, the handbook will include information of the following kind contained in the full range of important environments:

- Threshold stresses, survival tests, and time to failure by SCC in smooth and precracked specimens in all important environments
- Stress corrosion crack growth rates and stress intensity thresholds
- S-N curves, Goodman diagrams, and da/dN for fatigue tests
- Other information concerning the effects of environments on mechanical (design) properties of metallic materials, e.g. low cycle fatigue, creep, etc.

The handbook will contain chapters incorporating the above for the following alloy systems:

- carbon steels
- low alloy steels
- martensitic stainless steels
- ferritic stainless steels
- duplex stainless steels
- austenitic stainless steels
- nickel base alloys
- titanium alloys
- zirconium alloys
- magnesium alloys
- copper alloys
- aluminum alloys
- other alloy systems (less common metals, refractory metals, cast iron, etc.)

Moreover, it is planned to include sections concerned with:

- environmental cross reference
- testing techniques
- failure analysis and failure prevention
- procedures for interpreting and utilizing the data

Since your laboratories have contributed significantly to these topics, we are asking that you consider contributing such technical information to the handbook on stress corrosion and corrosion fatigue. To facilitate this, we could either keep your contribution confidential (i.e. without reference) or give you full credit for it in whatever form you desire. Your contribution would be a significant step toward the design of more reliable structures for the increasingly complex and aggressive environments of today’s technology.
Your contribution could consist of laboratory or field reports concerning the occurrence of stress corrosion or corrosion fatigue. We are looking for both raw data and analysis of conditions under which these processes can occur. As illustrations and for educational purposes, we are interested in both failure reports, analysis, and statistics of failures of various types.

We intend to use and present your information on stress corrosion cracking and corrosion fatigue in a constructive manner, pointing out not only where there is danger of cracking in certain material-environment combinations, but also where alloys and environments can be expected to give satisfactory service behavior.

We plan to prepare rough drafts of all the sections on the alloy systems mentioned above. If you agree, we will send these sections to you as they become available for review by you or your specialists. This is to provide you with an early overview of the present state of the art, and we would give you an opportunity to criticize, amend, and/or fill in gaps in the material covered.

We are looking forward to hearing from you concerning your possible contribution to the handbook on stress corrosion cracking and corrosion fatigue.

Please return the attached form at your earliest convenience. Following this we will arrange direct contact and further discussion of the data.

Sincerely yours,

R. W. Staehle
International Nickel Professor of Corrosion Science and Engineering

Markus O. Speidel
Visiting Research Professor

RWS/MOS:cgw

Enclosure
PARTICIPATION IN THE
ARPA HANDBOOK PROJECT IN
STRESS CORROSION CRACKING AND CORROSION FATIGUE

1. We (will/are not able to) participate in the Handbook Project.

2. The proper person in our organization to contact for reading the draft chapters and furnishing information is:
   Name:_________________________________________
   Address:_______________________________________
   Telephone:_____________________________________

   Other person in our organization who could furnish information on stress corrosion cracking, hydrogen embrittlement, and corrosion fatigue are:
   Name:_________________________________________
   Address:_______________________________________
   Telephone:_____________________________________
   Name:_________________________________________
   Address:_______________________________________
   Telephone:_____________________________________
   Name:_________________________________________
   Address:_______________________________________
   Telephone:_____________________________________

3. We have the following kinds of information available which might possibly be used:
   (Check or fill in blanks)
   (a) Laboratory data
      (i) Alloy Types
      yes no
(2) **Environments**

- (b) Failure analyses or descriptions relating to stress corrosion cracking or corrosion fatigue
  - **Types**
  - yes
  - no

- (c) Failure Statistics relating to stress corrosion cracking or corrosion fatigue
  - yes
  - no

- (d) Reprints and/or reports relating to stress corrosion cracking, corrosion fatigue, hydrogen embrittlement
  - yes
  - no

( ) We have other pertinent information as follows:

Please return to:

Dr. W. O. Speidel  
Visiting Research Professor  
Department of Metallurgical Engineering  
The Ohio State University  
116 West 19th Avenue  
Columbus, Ohio 43210
Appendix II. Stress corrosion specialists whose contribution of information to the handbook was solicited

ADLER, Dr. P.N., Grumman Aerospace Corporation, Bethpage, New York

AHMADIEH, Dr. Aziz, Pahlavi University, Shiraz, Iran

ALTENPOHL, Dr. Dieter G., Schweizerische Aluminium AG, Zurich, Switzerland

ANDERSON, Dr. William E., Battelle Pacific Northwest Lab, Richland, Washington

ARGON, Professor A., Massachusetts Institute of Technology, Cambridge, Mass.

ARUP, Dr. Hans, Korrosionscentralen, Copenhagen, Denmark

ARVIDSON, Mr. S., A.B. Bofors, Steel Laboratory, Bofors, Sweden

ASPEN, Dr. R.G., Westinghouse Electric Corporation, Pittsburgh, Pennsylvania

BARSON, Dr. John, U.S. Steel Corporation, Monroeville, Pennsylvania

BECK, Dr. Theodore R., Flow Research Incorporated, Kent Washington

BEGLEY, Mr. Richard T., Westinghouse, Pittsburgh, Pennsylvania

BELO, M. Da Cunha, Cptre National de la Recherche Scientifique, France

BENSON, Dr. Ray B. Jr., North Carolina State University, Raleigh, North Carolina

BERG, Mr. O., Central Institute for Industrial Research, Blindern-Oslo, Norway

BERGE, M.J.P., Electricite de France, Chatou, France

BERGH, Director K.G., Jernkontoret, Stockholm, Sweden

BERNSTEIN, Professor I.M., Carnegie Mellon University, Pittsburgh, Pennsylvania

BIANCHI, Professor G., University of Milano, Italy

BIRNBAUM, Dr. H.K., University of Illinois, Urbana, Illinois 61801

BLACKBURN, Mr. Martin J., Pratt & Whitney Aircraft, East Hartford Connecticut

BLOM, Dr. Uno, Sandvik A.B., Sandviken, Sweden

BOCKRIS, Professor O'M, Flinders University of South Australia, Bedford Park, Australia

BOHNEKAMP, Dr. K., Max-Planck-Institut fur Eisenforschung, Dusseldorf, Germany

BOMFORD, Dr. Michael J., Henry Wiggin & Co., Ltd., Hereford, England

BOMBARA, Dr. G., Centro Sperimentale Metallurgico, Roma, Italy
BOND, Dr. A.P., Climax Molybdenum Co., Ann Arbor, Michigan
BOYD, Mr. Walter, Battelle Memorial Institute, Columbus, Ohio
BRANDRY, Dr. Fatiyah Al, University College of Swansea, Glam, England
BRESSANELLI, Mr. Jerry, Crucible Materials Research Center, Pittsburgh, PA
BROWN, B.F., American University, Washington, D.C.
BRUNETAUD, Mr. M.R., S.N.E.C.M.A., Corbeil Essonnes, France
BRUNNER, Dr. Hans, Institut Dr. Straumann, Waldenburg, Switzerland
BRYANT, Mr. Robert E., Texaco, Inc., Port Arthur, Texas
BUCK, Mr. R.H., Kelsye Hayes Co., Philadelphia, Pennsylvania
BUNK, Dr. D.W., Institut fur Werkstofforschung, Porz-Wahn, Germany
BUSH, Dr. S. H., U.S. Atomic Energy Commission, Washington, D.C.
CARTER, Dr. Clive, The Boeing Company, Seattle, Washington
CASAD, Mr. B.M., Continental Oil Company, Ponca City, Oklahoma
CHANDLER, Dr. W., Rockwell International, Canoga Park, California
CHANGE, Prof. Frank C., Chem Kung University, Taiwan, Rep. of China
CHAWLA, Prof. Dr. K.K., Instituto Militar de Engenharia, Rio de Janeiro, Brazil
CHITTUM, Mr. Joseph K., Chevron Research Co., LaHabra, California
CIBA, Geigy AG, Klybeckstr, Switzerland
CLARK, Dr. W.G., Jr., Westinghouse, Pittsburgh, Pennsylvania
CLARKIN, Dr. P.C. Office of Naval Research, Arlington, Virginia
COCKCROFT, Dr. M.G., National Gas Turbine Establishment, Hants, United Kingdom
COFFIN, Dr. Louis, General Electric Co., Schenectady, New York
COHEN, Dr. Bennie, Aeronautical Systems Branch, Wright Patterson AFB, Ohio
COHEN, Dr. Norris, Massachusetts Inst. of Technology, Cambridge, Massachusetts
COLLINS, Mr. J.A., E.I. duPont de Nemours & Co., Wilmington, Delaware
CORDOVI, Dr. Marcel A., International Nickel Co. of Canada, Ltd., New York, New York
CORIOU, Dr. Henri, DCA/SECE, Fontenay aus Roses, France
CORTCH, Professor H., University of Illinois, Urbana, Illinois
COTTON, Dr. J.B., Scarborough, Yorkshire, England
COULTER, Mr. A.W., Dowell Division of Dow Chemical Co., Tulsa, Oklahoma
COUPER, Mr. A.S., American Oil Company, Whiting, Indiana
COUTSOURADIS, Mr. M.D., Centre de Recherches Metallurgiques, Liege, Belgium
COUHAN, Dr. Robert L., General Electric Company, Pleasanton, California 94566
COX, Dr. Brian, Atomic Energy of Canada Ltd., Chalk River, Ontario, Canada
CRAIG, Dr. H. Lee, Division of Ocean Engineering Atmospheric Science, Miami, Florida
CROOKER, Mr. T.W., Naval Research Laboratory, Washington, D.C.
CUNNINGHAM, J.E., Oak Ridge National Laboratory, Oak Ridge, Tennessee
DANKO, Dr. J.C., General Electric Company, San Jose, California
DAOTRONG, Dr. T., Division Production d'Energie, Le Bourget, France
DAS, Mr. K.B., The Boeing Company, Seattle, Washington
DAVIES, Prof. E., University College of Swansea, Glam, England
DAVIS, Dr. H.M., U.S. Army Research Office-Durham, Durham, North Carolina
DAVIS, Dr. Mark J., Sandia Laboratories, Albuquerque, New Mexico
DECKER, Dr. Raymond, International Nickel Company, New York, New York
DE BRAY, Dr. Werner, Siemens AG, Erlangen, Germany
DE LUCCIA, Naval Air Development Center, Warminster, Pennsylvania
DESESTRETE, Dr. Angre, Societe Creusot-Loire, Firminy, France
DETERT, Prof. Dr. Ing Klaus, AEC, Frankfurt, Germany
DEUTSCH, Dr. G., NASA, Washington, D.C.
DE VAH, Mr. Jack H., Oak Ridge National Laboratory, Oak Ridge, Tennessee
DEVEREUX, Professor O., University of Connecticut, Storrs, Connecticut
DILLON, Dr. R.L., Battelle Pacific Northwest Laboratories, Richland, Washington
DOLAH, Prof. Tom J., University of Illinois, Urbana, Illinois
DONATI, Dr. J.R., Electricite de France, Moret-sur-Loing, France
DORUK, Dr. M., Middle East Technology University, Ankara, Turkey
DRALEY, Dr. Joe, Argonne National Laboratories, Argonne, Illinois 60439
VAN DROFFELAAR, Dr. H., DuPont of Canada, Ltd., Hailton, Ontario, Canada
DUQUETTE, Dr. David J., Rensselaer Polytechnic Institute, Troy, New York
EKBOH, Mr. Ragnar, Stal-Laval Turbin AB, Finspang, Sweden
EFFERTZ, Dr. P.H., Allianz-Zentrum F. Technik GmbH, Ismaning, Germany
ENGELL, Professor H.J., Max-Planck-Institut für Eisenforschung, Dusseldorf, Germany
JESUITZER, Professor Erdmann, Technische Universität, Hannover, Germany
ESSLINGER, Dr. P., Motoren-und Turbinen Union, München-Allach, Germany
EVANS, Mr. G.B., Hawker Siddeley Aviation Ltd., Herts, United Kingdom
EVANS, Dr. U.R., Cambridge, Great Britain
FELTNER, Dr. Charles, Ford Motor Company, Dearborn, Michigan
FERRO, EHG. A.J.G. de Almeida, Centro de Investigacao, Sacavem, Portugal
FICHTER, Prof. Dr., EMPA, Dubendorf, Switzerland
FIDELLE, Dr. Jean-Pierre, C.E.A., Bruyeres-Le-Chatel, France
FISCHMEISTER, Prof. H., Chalmer Teknisk Hosgkola, Göteborg, Sweden
FORSYTH, Mr. P.J.E., Royal Aircraft Establishment, Hampshire, England
FORTY, Dr. A.J., University of Warwick, Coventry Warwickshire, England
FOURIE, Dr. J.T., National Physical Research Laboratory, Pretoria, South Africa
GALLAGHER, Dr. J.P., University of Illinois, Urbana, Illinois
GALLHAL, M.El, O.N.E.R.A., Chatillon, France
GALVELE, Dr. Jose, Comision Nacional de Energía Atomica, Buenos Aires, Argentina
GARLICK, Mr. A., Reactor Development Lab, Windscale, United Kingdom
GEADA, Prof. S.M., Instituto Nacional de Investigacao Industrial, Lisboa, Portugal
GEGEL, Dr. H.L., Wright-Patterson AFB, Dayton, Ohio
GEIGER, Dr. T., Gebruder Sulzer, AG, Winterthur, Switzerland
GERBERICH, Mr. William W., University of Minnesota, Minneapolis, Minnesota
GJOSTEIN, Dr. Norman, Ford Motor Company, Dearborn, Michigan
GLENHY, Dr. R.J.E., Royal Aircraft Establishment, Hants, United Kingdom
GODARD, Mr. Hugh P., Ontario, Canada
GORDON, Mr. Gerald H., General Electric Company, Pleasanton, California
GRAF, Dr. L., Wilhelmsplatz, Harback, Germany
GREENFIELD, Dr. P., G.E.G. Turbine Generators, Ltd., Leicester, England
GREER, Dr. James B., Esso Research Co., Houston, Texas
GRIMM, Mr. T.C., McDonnell Aircraft Company, St. Louis, Missouri
GOULD, Mr. George, General Electric Company, Schenectady, New York
GRUHL, Prof. Dr. Ing. W., Leichtmetall Forschungsinstitut, Bonn, W. Germany
GUNNARSON, Director Sten, Oxelosunds Jarnverk, Oxelosund, Sweden
HAHN, Dr. George, Battelle Columbus Laboratories, Columbus, Ohio
HARRISON, Dr. J.T., Gas Council Engr. Res. Station, Newcastle, England
HARTWIG, Dr. Ing. J., Krupp Forschungsinstitut, Essen, Germany
HAYCOCK, Mr. Ernie, Shell Development, Houston, Texas
HEADY, Mr. R.B., Shell Development Company, Houston, Texas
HEEMANN, Dr. R.F., Case Western Reserve University, Cleveland, Ohio
HEINRICH, Mr., Friedr. Krupp GmbH, Essen, W. Germany
HEITZ, Dr. Ewald, Gundelhardtstrasse, Kelkheim, Germany
HELFICH, Dr. Wayne J., Kaiser Aluminum & Chemical Co., Pleasanton, California
HEINTHORNE, Mr. M., The Carpenter Steel Co., Reading, Pennsylvania
HEUSLER, Prof. K.E., Universitat Clausthal, Clausthal, Germany
HIMMEL, Alusuisse, Neuhausen, Switzerland
HOAR, Dr. T.P., Cambridge, England
HOCHMAN, Dr. Robert F., Georgia Institute of Technology, Atlanta, Georgia
HUEPPNER, Dr. David, University of Missouri, Columbia, Missouri
HOFF, Mr. G., Dornier System GmbH, Friedrichshafen, W. Germany
HOFFMA-A Roche & Co. AG, Basel, Switzerland
HOLTAN, Prof., Dr. H, University of Trondheim, Trondheim, Norway
HOPKINS, Mr. B.E., National Physical Laboratory, Middlesex, England
HUBER, Dr. Walter, AB Atomenergi, Studsvik, Nykoping, Sweden
HUDIO, Mr. R.A.U., OECK, Winfrith, United Kingdom

12
HYATT, Dr. Michael V., The Boeing Company, Seattle, Washington

IVENS, Mr. G., Arbeitsgemeinschaft Versuchsreaktor AVT GmbH, Dusseldorf, Germany

IZUMIYAMA, Dr. Masao, Japan Gasoline Co., Ltd., Yokohama, Japan

JACOBS, Dr. A.J., Rocketdyne, Canoga Park, California

JAFFEE, Dr. Robert I., Electric Power Research Institute, Palo Alto, Calif

JOHNSON, Prof H.H., Cornell University, Ithaca, New York

JOHNSON, Dr. H.R., Sandia Laboratories, Livermore, California

KAESCHE, Prof. Dr. H. Kaesche, Universitat Erlangen, Erlangen, Germany

KAPPELT, Mr. George F., Bell Aerosystems Co., Buffalo, New York

KAWASHIMA, Dr. Asahi, Tohoku University, Sendai, Japan

KEAR, Dr. Bernard, Pratt & Whitney Aircraft, Hiddletown, Conn.

KESEY, Dr. R., Aluminum Company of America, Alcoa Technical Center, Pennsylvania

KERSHOF, Prof. Dr. Frank, Institut F. Festkorpermechanik, Freiburg, W. Germany

KITAGAWA, Prof. H., Tokyo University, Tokyo, Japan

KNOX, Mr. J.A., Halliburton Co., Duncan, Oklahoma

KOFSTAD, Dr. Per, Central Institute for Industrial Research, Blindern-Oslo, Norway

KOHL, Dr. Heinz, Schoeller Bleckmann Stahlwerke, Ternitz, Austria

KONDO, Dr. Tatsuo, Japan Atomic Energy Res. Inst., Ibaraki-ken, Japan

KOWAKA, Dr. Masamichi, Sumitomo Metal Industries, Amagasaki, Japan

KRAFT, Dr. Joseph, Naval Research Laboratory, Washington, D.C.

KRAINER, Dr. E., Gebr. Bohler & Co. AG, Kapfenberg, Austria

KRUGER, Dr. Jerome, National Bureau of Standards, Washington, D.C.

LACOMBE, Dr. Paul, Universite Paris Sud, Orsay, France

LAIRD, Dr. Campbell, University of Pennsylvania, Philadelphia, Pennsylvania

LAMOTTE, Dr. E. de, Westinghouse Research Lab., Brussels, Belgium

LARDOLT, Prof. Dr. Dieter, Ecole Polytechnique Federale, Lausanne, Switzerland

LANGER, Dr. G.F., Westinghouse Electric Corporation, Pittsburgh, Pennsylvania

LATANISIOH, Dr. Ron, Max-Planck-Institut fur Eisenforschung, Dusseldorf, Germany
LEACH, Dr. James, University of Nottingham, Nottingham, England
LECKIE, Dr. Harry P., Inland Steel Co., East Chicago, Indiana
VAN LEEUWEN, Dr. H.P., National Aerospace Lab. NLR, Amsterdam, Netherlands
LEVY, Dr. Sandor S., Reynolds Aluminum, Richmond, Virginia
LINDSTRA, Mr. Erik, Granges Essem, Finspang, Sweden
LIPSITT, Dr. Harry S., Wright-Patterson Air Force Base, Ohio
LITTMANN, Dr. Walter E., The Timken Company, Canton, Ohio
LORENZ, Mr. Roy, Combustion Engineering Co., Chattanooga, Tennessee
LOUTHAI, Dr. H.R., DuPont Company, Aiken, South Carolina
LOVELACE, Dr. A.M., Wright-Patterson AFB, Ohio
LOW, Dr. J.R., Carnegie Mellon University, Pittsburgh, PA
LUSTMAN, Dr. D., Westinghouse Electric Corp., West Mifflin, Pennsylvania
MAGNANI, Dr. H.J., Sandia Laboratories, Albuquerque, New Mexico
MANSFIELD, Dr. F., Rockwell Internation, Thousand Oaks, Calif 91360
MACHERAUCH, Prof. Dr. E., Inst. F. Werkstoffkunde, Karlsruhe, W. Germany
MARDONET, H. Bernard, IRSID, St Germain en Laye, France
HARCUS, Dr. H. L., Rockwell International, Thousand Oaks, California
HARTA, Dr. E. Santa, Laboratorio de Fisica e Engenharia Nucleares, Sacaven, Portugal
Mattsson, Dr. E., Swedish Board for Technical Development, Stockholm, Sweden
MAYER, Mr. K.H., Maschinenfabri, Augsburg-Nurnberg, Nurnberg, Germany
MCCLINTOCK, Professor Dr. F., Massachusetts Institute of Technology, Cambridge, Mass
MC EVILY, Prof. Dr. A., University of Connecticut, Storrs, Connecticut
MC NARY, Dr. T.A., Babcock & Wilcox, Alliance, Ohio
MC NITT, Virginia Polytechnic Institute and State University, Blacksburgh, Virginia
MC MAHON, Prof. Dr. Charles, University of Pennsylvania, Philadelphia, Pennsylvania
MITSCH, Prof. Dr. R., Institut f. Metallkunde, Leoben, Austria
MOON, Dr. David, Westinghouse Electric Corp., Pittsburgh, Pennsylvania
MONTUELLE, M. Jean, C.H.R.S., Vitry, France
MURATA, Dr. Tom, Nippon Steel Corporation, Kawasaki, Japan
NEILL, Mr. W.J. Jr., Humble Oil and Refining Co., Linden, New Jersey
NELSON, Mr Howard G., Ames Research Center, Moffett Field, Calif 94305
NICHOLSON, Dr. R. B., International Nickel Company, Birmingham, England
NIEDER, Mr. R., Arbeitsgemeinschaft Versuchsreaktor AVR GmbH, Dusseldorf, Germany
NIELSEN, Mr. N.A., DuPont Experimental Station, Wilmington, Delaware
NORGERG, Mr. L. A., Stal-Laval Turbine AB, Finspong, Sweden
NORDIN, Mr. S., Uddeholm Company, Hagfors, Sweden
NOVAK, Dr. Steve, U.S. Steel Corporation, Monroeville, PA
NOVOTNY, Prof. Dr. Hans, Universitat Wien, Wien, Austria
OKADA, Dr. Hideya, Nippon Steel Corporation, Kawasaki, Japan
OKKERSE, Dr. B., Technische Hoge School Delft, Delft, Netherlands
ORIANI, Dr. Richard, U.S. Steel Corporation, Monroeville, Pennsylvania
OSOZAWA, Nippon Yakin Kogyo Co. Ltd, Kawasaki, Japan
OSTBERG, Docent Gustav, AB Atomenergi, Nykoping, Sweden
PACKER, Dr. Kenneth F., Packer Engineering Associates Inc., Naperville, Illinois
PANIC, Mr. Bozidar, Laboratorium fur Formfestigkeit, Winterthur, Switzerland
PARIKH, Dr. M., IIT Research Institute, Chicago, Illinois
PARKINS, Dr. R.N., University of Newcastle, United Kingdom
PATON, Dr. H.E., Rockwell International, Thousand Oaks, California 91360
PATTON, Prof. Dr. C.C., University of Oklahoma, Norman, Oklahoma
PAXTON, Dr. H.W., Carnegie-Mellon University, Pittsburgh, Pennsylvania
PELLOUX, Dr. Regis M., Mass Institute of Technology, Cambridge, Mass
PEMMENT, Dr. Fred, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania
PEMSLER, Dr. J. Paul, Kennecott Copper Corp., Lexington, Mass.
PHELPHS, Dr. E.H., United States Steel Corporation, Monroeville, Pa
PICKERING, Dr. Howard W., Pennsylvania State University, University Park, Pennsylvania
PIPER, Dr. D. E., Lockheed Palo Alto Research Laboratory, Palo Alto, California

POCOCK, Mr. Fred, Babcock & Wilcox Company, Alliance, Ohio

POLMEAR, Prof. Jan I., Monash University, Clayton, Victoria

POPPELWELL, Dr. J., Olin Metals Division, New Haven, Connecticut

POURBAIX, Dr. Marcel, Cebelcor, Bruxelles, Belgium

POWELL, Dr. G.L., Oak Ridge Y-12 Plant, Oak Ridge, Tennessee

PROCTOR, Dr. R. University of Manchester, Manchester, England

PRYOR, Dr. M.H. Olin Metals Division, New Haven, Conn.

PUGH, Prof. E.H., The University of Illinois, Urbana, Illinois

RAHIEL, Dr., Dechema, Frankfurt, Germany

RICE, PROGRESSOR J., Brown University, Providence, Rhode Island

RIDEOUT, Mr. Sheldon, DuPont Company, Aiken, South Carolina

ROBERTS, Dr. E.I., Gulf General Atomic Co., San Diego, California

RCHDE, Dr. R.W., Sandia Laboratories, Albuquerque, New Mexico

RONALD, Dr. T., Wright Patterson AFB, Dayton, Ohio

ROSLER, Prof. Dr., U., Siemens AG, Erlangen, W. Germany

RUSSO, Prof. Ettore Di., Instituto Sperimentale Dei, Novara, Italy

SAITO, Prof. Norio, Hokkaido University, Sapporo, Japan

SAHATZKY, Dr. A., Atomic Energy of Canada, Ltd., Manitoba, Canada

SCHMIDT, Dr. Thomas, Institut fur Metallkunde Universitat Munchen, Germany

SCHMIDT, Mr. M., A/S Nordiske Kabel og Tradfabrikker, Glostrup, Denmark

SCHUBERT, Mr. F., DEW, Krefeld, Germany

SCOTT, Dr. Tom E., Iowa State University, Ames, Iowa

SCULLY, Dr. J.C., University of Leeds, Leeds, United Kingdom

SCHULTZ, Dr. Ing., Industrieanlagen Betriebsgesellschaft mbH, Munchen, Germany

SHAHINIAN, P., Naval Research Laboratory, Washington, D.C.

SHIBATA, Dr. Toshio, Hokkaido University, Sapporo, Japan
SHIMODAIRA, Dr. S., Tohoku University, Sendai, Japan
SHREIR, Dr. L.L., City of London Polytechnic, London, England
SKOULIKIDIS, Prof. Dr. Ing. Th., Athens, Greece
SLATTERY, Mr. G.F., UKAEA, Springfields, United Kingdom
SLUYS, Dr. Vander, Babcock & Wilcox, Alliance, Ohio
SMITH, Dr. G.C., Cambridge University, Cambridge, England
SMITH, Mr. W.R., Bechtel Corporation, San Francisco, California
SNYRL, Dr. William, Sandia Laboratories, Albuquerque, New Mexico
SOLOMON, Dr. H., General Electric Corporation, Schenectady, New York
SPAHH, Dr. H., BASF, Ludwigshafen, Germany
SPECKHARDT, Prof. H., Institut fur Werkstoffkunde, Darmstadt, Germany
SPROWLS, Dr. D.O., Alcoa Company of America, Alcoa Center, Pennsylvania
STANZL, Dr. St., Universitat Wien, Wien, Austria
STEPHENS, Dr. Joseph R., NASA Lewis Research Center, Cleveland, Ohio
STICKLER, Prof. R., Universitat Wien, Wien, Austria
STIEDING, Dr. Lothar, Kraftwerk Union A.G., Erlangen, Germany
STOLICA, Dr. Nicholas, Munster, Germany
STOLOFF, Dr. N.S., Rensselaer Polytechnic Institute, Troy, New York
STRAW, Mr. R.L., Caterpillar Tractor Co., Peoria, Illinois
STRINGER, Prof. J., University of Liverpool, Liverpool, United Kingdom
SWAUN, Dr. P. R., Imperial College, London, England
SWAISON, Dr. Theodore, Shell Development Co., Houston, Texas
SYLWESTROWICZ, Dr. W.D., Bell Telephone Laboratories, Inc., Murray Hill, N.J.
TAKANO, Mr. Shiro, Mitsuitoatsu Chemicals, Inc., Tokyo, Japan
TANIMUR, Dr. Masayuki, Mippon Kokan Co. Ltd, Kanagawa-ken, Japan
TAYLOR, Mr. J.W., Babcock & Wilcox(Ops)Ltd., Renfrew, Scotland
TEDMON, Dr. Craig S., General Electric Corporation, Schenectady, New York
TETELMAN, Prof. A.S., University of California, Los Angeles, California
THIRUVENGADAM, Dr. A., Catholic University of America, Washington, D.C.
THOMPSON, Dr. Anthony H., Rockwell International, Thousand Oaks, California
THOMPSON, Dr. David, Reynolds Aluminum, Richmond, Virginia
THOMPSON, Dr. David H., Cliff Island, Maine
TIFFANY, Dr. Charles, ASD-ENF, Wright Patterson AFB, Ohio
TILLER, Professor William A., Stanford University, Stanford, California
TIPLER, Mr. H.R., National Physical Laboratory, Middx, England
TOWNSEND, Dr. H.E., Bethlehem Steel Corporation, Bethlehem, Pennsylvania
TRICOT, H.R., Chef des Laboratoires d'Ugine Aciens, Ugine, France
TROIANO, Prof. A.R., Case Western Reserve University, Cleveland, Ohio
TROIANIS, Dr. Desmond, University of British Columbia, Vancouver, British Columbia
TRUAX, Mr. Donald J., Standard Oil Company of California, Richmond California
TUITT, Mr. D.A., Rolls-Royce Ltd., Watford, England
TRUMAN, Mr. J.E., Brown-Firth Research Laboratories, Sheffield, England
TYZACK, Mr. C., UKAEA, Springfields, United Kingdom
UHLIG, Professor H., Massachusetts Institution of Technology, Cambridge, Mass.
VARGA, Dr. T., Gebruder Sulzer AG, Winterthur, Switzerland
VERINK, Dr. Ellis, University of Florida, Gainesville, Florida
VERMILYEA, Dr. D.A., General Electric Company, Schenectady, New York
VETTER, Prof. Dr., Freie Universitat Berlin, Berlin, Germany
WALLWORK, Dr. Greig R., University of New South Wales, New South Wales, Australia
WALTER, Dr. R.J., Rocketdyne Division, Rockwell International, Canoga Park, Calif.
WARBURTON, Mr. J.B., UKAEA, Didcot, United Kingdom
WARD, Dr. J., Central Electricity Research Laboratories, Surrey England
WECHSLER, Professor M.S., Iowa State University, Ames, Iowa
WEI, Professor R. P., Lehigh University, Bethlehem, Pennsylvania
WESTBROOK, Dr. J.H., General Electric Company, Schenectady, New York
WESTWOOD, Dr. A.R.D., Martin Marietta Corp., Baltimore, Maryland
WETTERFALL, Mr. Sven-Erik, ASED, Vasteras, Sweden
WHEELAHAM, Mr. E.J., Ge & Md, US Army Ms1, Redstone Arsenal, Alabama
WHITE, Dr. C.H., Henry Wiggin & Co., Ltd., Hereford, England
WILCOX, Dr. B., Battelle Columbus Laboratories, Columbus, Ohio
WILDE, Dr. B.E., U.S. Steel Corporation, Monroeville, Pennsylvania
WILLIAMS, Dr. J.C., Rockwell International, Thousand Oaks, California
WILSON, Dr. Ian, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania
WITT, Dr. Ing. A., Klockner Humboldt Deutz AG, Oberursel, Germany
WRIGHT, Mr. J.E., Alcan International Limited, Ontario, Canada
WORZALA, F.J., University of Wisconsin, Milwaukee, Wisconsin
YAHALOM, Dr. Joseph, Technion, Haifa, Israel
YAHAMOTO, Dr. Katsumi, Japan Gasoline Co., Ltd., Yokohama, Japan
ZEBROSKI, Dr. Edward, Electric Power Research Institute, Palo Alto, California
Appendix III. Some remarks that reached us with the returned questionnaires.

"...our laboratory scientists will participate in a major way..." C.R. Isleib, INCO, New York.

"The Handbook of Stress Corrosion Cracking and Corrosion Fatigue of Metallic Materials, looks like a very ambitious undertaking and one that will be very worthwhile to the metallurgical community." Honrace S. Wechsler; Chairman, Dept. of Metallurgy; and Chief, Metallurgy Division Ames Laboratory, USAEC.

"I will be happy to contribute in whatever way I can to this project, which sounds to be an effort which could be of great benefit to everyone interested in this problem area." B. Cox; Head, Materials Science Branch; Chalk River Nuclear Laboratories; Atomic Energy Commission.

"Packer Engineering would be happy to assist in the preparation of the handbook." Kenneth F. Packer, President, Packer Engineering Associates.

"...our group at Georgia Tech would be happy to assist in whatever way we can either through contributions and information, reviewing draft chapter, or providing editorial comments." Robert F. Hochmann; Associate Director for Metallurgy; Georgia Institute of Technology; Atlanta, Georgia.

"Roger: It must be very stimulating to be working with Mark Speidel, Harry Paxton, Walt Boyd, and Floyd Brown on this important project. We would be pleased to cooperate in reviewing draft chapters and in any other way which seems appropriate. We also would be pleased to add information from our work." Ellis D. Verink; Chairman, Dept of Materials Science and Engineering; University of Florida; Gainesville.
"...the handbook on stress corrosion cracking is an excellent idea and Dr. Troiano and I would be happy to contribute in any way possible..." R. F. Hehemann; Professor of Physical Metallurgy; Case Western Reserve University; Cleveland, Ohio.

"I will participate in the ARPA Handbook Project. I will be glad to supply reports we have written and will review the draft chapter..." Joseph R. Stephens, Materials Development Section, Lewis Research Center, NASA.

"...sounds like an ambitious—most worthwhile project." J. Krafft; Naval Research Laboratory; Washington, D.C.

"Glad to see you have a good project" George F. Kappelt, Bell Aerospace Company.

"The handbook project is certainly most useful and valuable" Per Kofstad; Central Institute for Industrial Research; Oslo, Norway.

"We are very glad to cooperate...copies of papers are air mailed to you today" M. Kowaka; Senior Research Engineer; Central Research Laboratories; Sumitomo Metals Industries; Amagasaka, Japan.

"...nous acceptons de participer à votre project The Handbook...nous nous tenons à votre disposition pour tous renseignements complémentaires." M. El Gammal; Le Directeur Scientifique Office National d'Etudes et de Recherches Aerospatiales (ONERA); Chatillon, France.

"...we participate in collaborative Swedish investigations into stress corrosion crack propagation as well as initiation of corrosion fatigue and we should be delighted to discuss this with you..." Bertil Aarcnson; Manager, Uddeholm Steel Research; Hegfors, Sweden.
"It is a pleasure to participate in the Handbook Project in SCC and CF."
Norio Sato; Professor of Electrochemistry; Faculty of Engineering; Hokkaido University; Sapporo, Japan.

"...your project of collecting and presenting available SCC data is extremely useful..." Dieter Landolt, Professor of Chemical Metallurgy, Ecole Polytechnique Federale De Lausanne, Switzerland.

"...I will pleasantly contribute to the handbook..." Prof. Dr. Th. Skoulikidis; Director, Laboratory of Physical Chemistry and Applied Electrochemistry; National Technical University of Athens; Greece.

"...very interesting and comprehensive proposals..." R.B. Nicholson; Director of Research and Technical Development; International Nickel Limited; Birmingham, England.

"Wir halten Ihr Vorhaben für ausserordentlich wertvoll, so dass wir Ihre Pläne gern unterstützen wollen...“ A. Rahmel, DEHEMA, Frankfurt, Germany.

"I think your ARPA project is a noble, if ambitious, one. I will of course be honored to assist in this project in any way that I can..." E.J. Wheelahan, Ch., Materials Function, G.E. and M. Dir. U.S. Army Missile RD & E Lab, Redstone Arsenal, Alabama.