

TABLE OF CONTENTS

VOLUME 1

Preface	v
Committees	vi
Opening Address	
E. VAN SPIEGEL	xxv
Welcome Address	
C. MAISONNIER	xxix

INVITED PAPERS

JET Results and the Prospects for Fusion	
P.H. REBUT and P.P. LALLIA	1
Progress in Fusion Technology in the U.S. Magnetic Fusion Program	
R.J. DOWLING, D.S. BEARD, G.M. HAAS, A. OPDENAKER and T.V. GEORGE	23
Progress in the Japanese Fusion Technology Programme	
T. IJIMA	35
NET and the European Fusion Technology Programme	
R. TOSCHI	47
NET Safety Analyses and the European Safety and Environmental Programme	
J. RAEDER and W. GULDEN	63
Technology Transfer from Research and Development to European Industry	
H. CONRADS and R. THEENHAUS	85
Key Components of the JET Active Gas Handling System – Experimental Programme and Test Results	
J.L. HEMMERICH, A.H. DOMBRA, J. GOWMAN, E. GROSKOPFS, R. HAANGE, A. KONSTAN- TELLOS, E. KÜSSEL, R. LÄSSER, P. MILVERTON, K. WALKER and K. WALTER	93
Breeding Blanket Development for NET	
J.E. VETTER	101
Blanket Testing in NET	
M. CHAZALON, W. DAENNER and B. LIBIN	115
NET Plasma Facing Components	
G. VIEIDER, M. HARRISON and F. MOONS	125
Reliability and Availability Issues in NET	
R. BÜNDE	139
Erosion and Deposition Processes in Tokamaks	
G.M. MCCRACKEN, P.C. STANGEBY, D.H.J. GOODALL and C.S. PITCHER	151
Plasma Heating – A Comparative Overview for Future Applications	
R. WILHELM	167
High Temperature Superconducting Materials and their Prospects for Large, High Field, Magnetic Coils	
G. PATERNO	181
Electromagnetic Compatibility, Essential for Fusion Experiments	
P.C.T. VAN DER LAAN	189

The JET Experience with Remote Handling Equipment and Future Prospects	
T. RAIMONDI	197
Preparation for D-T Operation at JET	
A.C. BELL, C. CALDWELL-NICHOLS, J. CAMPBELL, P. CHUILON, C. GORDON, G. NEW- BERT and M.E.P. WYKES	209
Prospects of Ceramic Tritium Breeder Materials	
E. ROTH, J. CHARPIN and N. ROUX	219
Low Activation Structural Materials for Fusion	
G.J. BUTTERWORTH	231
A Role for Free Electron Lasers in Fusion	
M.J. VAN DER WIEL and P.W. VAN AMERSFOORT	245
Muon Catalyzed Fusion	
C. PETITJEAN	255

CONTRIBUTED PAPERS

Section I: Experimental Systems

Engineering Features of the Tokamak de Varennes	
P.B. CUMYN and J.P.F. ROSEN	267
The Components of the Asdex Upgrade Tokamak System and the Assembly	
W. KÖPPENDÖRFER, M. BLAUMOSER, S. CHA, C. DORN, G. GERNHARDT, J. GRUBER, D. JACOBI, H. KOLLITZEK, E. LACKNER, M. PILLSTICKER, H. PREIS, H. SCHNEIDER, S. SCHWEIZER, U. SEIDEL, B. SOMBACH, B. STREIBL, H. VERNICKEL, X. WANG, P. WENG, F. WERNER and A. WIECZOREK	272
Engineering Aspects of RTP	
O.G. KRUIJT, A.B. STERK, G. VAN DIJK, P. HELLINGMAN and A.A.M. OOMENS	277
Analysis of the Plasma Equilibrium Evolution in the Presence of Circuits and Massive Conducting Structures	
R. ALBANESE	281
JT-60 Upgrade Program	
M. KIKUCHI, T. ANDO, M. ARAKI, T. HORIE, H. HORIIKE, Y. IKEDA, H. KISHIMOTO, K. KOIZUMI, M. MATSUKAWA, T. MATSUKAWA, Y. NEYATANI, H. NINOMIYA, T. NISHITANI, S. SEKI, H. TAKATSU and M. YAMAMOTO	287
JT-60U System Design	
M. MATSUKAWA, T. ANDO, M. ARAKI, T. HORIE, H. HORIIKE, Y. IKEDA, M. KIKUCHI, H. KISHIMOTO, K. KOIZUMI, T. MATSUKAWA, Y. NEYATANI, H. NINOMIYA, T. NISHITANI, S. SEKI, H. TAKATSU and M. YAMAMOTO	293
Engineering Features, Assembly Equipment and Installation Procedures of the FTU Machine	
R. ANDREANI, A. CECCHINI, M. GASPAROTTO and A. PIZZUTO	298
Protection of First-Wall Hardware During High-Power Neutral Beam Injection into TFTR	
D. MUELLER, M.G. BELL, L. GRISHAM, R.J. HAWRYLUK, F. JOBES, R.J. MARSALA, V.J. MASTROCOLA, G. RENDA and M.A. ULRICKSON	303
Operational Experience of JET Surface Physics Diagnostics	
C.J. HANCOCK, D. JAKOB, G.F. NEILL, P. PRIOR, C. NICHOLSON, A.L. STEVENS and J. VINCE	309
Design of a Thomson Scattering Diagnostic System to Measure Fast Ion- and Alpha-Particle Distributions in Jet	
J.A. HOEKZEMA, A.E. COSTLEY, T.P. HUGHES, N.P. HAMMOND, H.J. BARKLEY, W. KASPAREK, G.A. MÜLLER, L. REBUFFI, P.G. SCHÜLLER and M. THUMM	314

A Numerical Model of the JET Poloidal Circuit P. RUTTER, T. BONICELLI, A. SANTAGIUSTINA, P.R. THOMAS and B. TUBBING	319
The Performance of JET PF System for 7MA Material Limiter and 5MA Magnetic Limiter Operation A. SANTAGIUSTINA, E. BERTOLINI, T. BONICELLI, M. HUART, J. LAST, P. LOMAS, V. MARCHESE, P.L. MONDINO, P. NOLL, F. PETREE, C. RAYMOND and A. TANGA	324
The Design, Construction, Installation and Testing of a Boost Amplifier for the Vertical Field Power Supply of JET M. HUART, G.L. BASILE, D. CISCATO, O. BUC and J.K. GOFF	330
Design of the Protection Crowbar for the LHCD Klystrons in JET C. CHRISTODOULOPOULOS, D. CROSS, H. HRABAL, E. BERTOLINI, R. CLAESEN and W. WEIGAND	337
The Design of an Inner Poloidal Divertor for the Text Tokamak P.H. EDMONDS, E.R. SOLANO, A.J. WOOTTON, D. GAO, X. MAO, G. LI and W. ZHU	342
Beam-Guiding System for Rutherford-Scattering Diagnostic at Textor A. COSLER, H.W. VAN DER VEN, E.P. BARBIAN, G. BERTSCHINGER, A.A.E. VAN BLOK-LAND and E. KEMMEREIT	347
MEQALAC, A 1 MeV Multi-Channel RF-Accelerator for Light Ions J.G. BANNENBERG, W.H. URBANUS, R.G.C. WOJKE, H. KLEIN, A. SCHEMPP, R.W. THOMAE, T. WEIS and P.W. VAN AMERSFOORT	351
T-15 Results: Testing of Systems and Parts N.S. CHEVEREV, E.N. BONDARCHUK, V.A. GLUKHIH, S.P. GURIN, L.B. DINABURG, N.I. DOINIKOV, M.V. JELANSKY, V.G. IVKIN, V.V. KALININ, B.G. KARASIOV, Yu.A. KONSTANTINOV, E.V. KORNAKOV, A.N. KOSTENKO, V.G. KUCHINSKY, R.N. LITUNOVSKY, V.V. MAKAROV, I.F. MALYSHEV, J.V. MOZIN, N.A. MONOSZON, V.P. MURATOV, V.N. ODINTSOV, Yu.N. OSTROUMOV, V.N. PEREGUD, I.M. ROIFE, I.I. SABANSKY, E.V. SEREDENKO, F.M. SPEVAKOVA, Yu.V. SPIRCHENKO, G.V. TROKHACHEV, G.F. CHURAKOV, A.H. YAVNO, V.V. ALIKAEV, V.A. ALHIMOVICH, I.O. ANASHKIN, N.N. BRITOUSOV, E.P. VELIKHOV, A.N. VERTIPOROKH, A.N. VOLOBUEV, D.P. IVANOV, B.B. KADOMTSEV, I.A. LELEKHOV, V.V. MARTYNNENKO, L.A. MATALIN-SLUTSKY, I.A. POSADSKY, N.N. SEMASHKO, B.A. STAVISSKY, V.L. STRELKOV, G.N. TILININ, P.P. HVOSTENKO, N.A. CHERNOPLEKOV, V.M. SCHEDROV, V.D. KORALENKO and G.Yu. TSFASMAN	356
Compass Machine Design and Construction R.J. HAYWARD, P.J. CRAWLEY, R.T. CROSSLAND, B.S. INGRAM, A.P. PRATT and R.T.C. SMITH	361
Mechanical Assembly and Tests of the Tore Supra Components J.J. CORDIER, R. AYMAR, D. BESSETTE and C. DECK	366
Low Noise Bolometric Diagnostics for Asdex-Upgrade and Tore-Supra C. ANDELFINGER, F. MAST, G. SCHRAMM, P. VALLET and G. WEBER	374
Vertical Field Systems in TPE-1RM15 Reversed Field Pinch Experiment T. SHIMADA, Y. HIRANO, Y. YAGI, K. OGAWA, M. YAMANE, S. YAMAGUCHI, I. OYABU and S. MURAKAMI	379
Design of STP-3(M) Reversed-Field Pinch with High Current Density S. YAMADA, H. ARIMOTO, M. YAMANE, S. YAMAGUCHI, T. TSUKAMOTO, A. NAGATA, S. MASAMUNE and K. SATO	386
Final Assembly and Initial Operation of the Advanced Toroidal Facility B.E. NELSON	391
Reduction of Error Field in CHS K. NISHIMURA, K. MATSUOKA, M. FUJIWARA, H. YAMADA, S. OKAMURA, H. IGUCHI, M. HOSOKAWA, K. IDA, S. IMAGAWA, T. MASUMOTO and Y. ITOU	398

Engineering Design Study of the Large Superconducting Helical Device O. MOTOJIMA, K. YAMAZAKI, T. MUTOH, Y. TAKEIRI, T. KURODA, S. KITAGAWA, N. OHYABU, I. OHTAKE, M. TAKEO, S. SUDO, S. MORIMOTO, K. MATSUOKA, M. FUJIWARA, A. IYOSHI and LARGE HELICAL DESIGN TEAM	402
Comparative Design Study of Super- vs. Normal-Conducting Large Helical System K. YAMAZAKI, O. MOTOJIMA, S. MORIMOTO, K. NISHIMURA, T. MIZUUCHI, H. KANEKO, K. MATSUOKA, T. HINO, M. TAKEO, O. TSUKAMOTO, K. NOTO, T. MUTOH, Y. TAKEIRI, S. KITAGAWA, T. KURODA, N. OHYABU, I. OHTAKE, M. FUJIWARA, A. IYOSHI and LARGE HELICAL DESIGN TEAM	407
Manufacturing of Compact Helical System S. IMAGAWA, Y. SHIMANUKI, T. MASUMOTO, Y. ITOU, K. NISHIMURA, K. MATSUOKA and M. FUJIWARA	412
Magnetic Field, Force and Stress Calculations for Modular Helias Coil Systems J. KISSLINGER, E. HARMEYER, A. MONTVAI, F. RAU and H. WOBIG	417
 <i>Section II: Plasma Heating and Equilibrium</i>	
The ECRH System on CT-6B Tokamak Y. LUO and S. YANG	423
Commissioning and Test Operation of the Pulsed High Voltage Modulator with Inductive Energy Storage for 1MW ICRH System in CAS-IPP Z.Z. LIU, Y.D. PAN, X.B. LI and Z. FENG	427
The Development of Plasma-Heating Equipment and Classical High-Power Broadcast Transmitter Technology W. SCHMINKE	432
Elliptical Polarization for ECRH on RTP P. MANINTVELD and A.G.A. VERHOEVEN	438
RF Window Development for High Power Gyrotrons at Asea Brown Boveri G. AGOSTI and H.-G. MATHEWS	443
The JET ICRF Antennae Screen: Experience with the Actively Cooled Nickel Screen and Design of a New Beryllium Screen C.I. WALKER, H. BRINKSCHULTE, M. BURES, N. DRAGOMELO, J.P. COAD, A.S. KAYE, S. KNOWLTON and J. PLANCOULAIN	444
The Design of the JET Lower Hybrid Launcher A.S. KAYE, H. BRINKSCHULTE, G. EVANS, C. GORMEZANO, J. JACQUINOT, S. KNOWLTON, X. LITAUDON, D. MOREAU, M. PAIN, J. PLANCOULAIN, C.I. WALKER and G. WILSON	449
Design of JET Lower Hybrid Current Drive Generator and Operation of High Power Test Bed J.A. DOBBING, G. BOSIA, M. BRANDON, M. GAMMELIN, C. GORMEZANO, J. JACQUINOT, G. JESSOP, M. LENNHOLM, M. PAIN, A. SIBLEY and T. WADE	454
32 MW ICRH Plant Operation Experience on JET G. BOSIA, M. SCHMID, J. FARTHING, S. KNOWLTON, A. SIBLEY, T. WADE and E. NEGRO	459
Installation, Testing and First Results of Textor's New ICRH System F. DURODIÉ, T. DELVIGNE, P. DESCHAMPS, R. KOCH, A.M. MESSIAEN, J. ONGENA, P.E. VANDENPLAS, R. VAN NIEUWENHOVE, G. VAN OOST, X.M. SHEN, R.R. WEYNANTS, P. HÜTTEMAN, W. KOHLHAAS, C. STICKELMANN, B. BRANDT and A. COSLER	464
Technical and Operational Experience with the Long-Pulse ICRH Transmission Lines on ASDEX H. WEDLER, W. BECKER, R. FRITSCH, F. HOFMEISTER, J.-M. NOTERDAEME and F. WESNER	469
The ICRH Technical System for Wendelstein VII-AS F. WESNER, J.-M. NOTERDAEME, J. BÄUMLER, W. BECKER, F. BRAUN, R. FRITSCH, P. GRIGULL, F. HOFMEISTER, A.B. MURPHY and H. WEDLER	475

A 650 kW 3.7 GHz Klystron for Current Drive and Plasma Heating Ch. BASTIEN and C. BEARZATTO	480
Lower Hybrid Waves for Current Drive and Heating in Reactors J. YUGO, S. BERNABEI, P. BONOLI, R.S. DEVOTO, M. FENSTERMACHER, M. PORKOLAB and J. STEVENS	485
Microwave Technology and Tests of the 70 GHz/1 MW Long-Pulse ECRH System on the Advanced Stellarator W VII-AS W. KASPAREK, H. KUMRIĆ, G.A. MÜLLER, P.G. SCHÜLLER, M. THUMM and V. ERCKMANN	490
A High Yield RF Plasma Source for Neutral Beam Injection Systems W. KRAUS and M. KAUFMANN	495
Asymmetric Modes in Gyrotron Tubes and their Experimental Study P. GARIN, E. JEDAR, G. JENDRZEJCZAK, G. MOURIER, F. PAYEN and L. TEYSSIER	499
Tore Supra ICRH Antennae Array B. BEAUMONT, G. AGARICI and H. KUUS	503
The ICRH System for Tore Supra H. KUUS, G. AGARICI, B. BEAUMONT and R. BRUGNETTI	508
The 3.7 GHz Launcher of Tore Supra and Related Conditioning Results for Quasi Continuous Pulses G. REY, R. AYMAR, G. BERGER-BY, Ph. BIBET, M. GONICHE, P. HERTOOUT, R. MAGNE, C. PORTAFAIX and G. TONON	514
Scattering Matrix of Tore Supra Lower Hybrid Antenna Module Prototype Ph. BIBET, J. ACHARD, G. BERGER-BY, M. GONICHE, R. MAGNE, G. REY and G. TONON	519
The Tore Supra Lower Hybrid Transmitter R. MAGNE, R. AYMAR, G. BERGER-BY, Ph. BIBET, M. GONICHE, G. REY and G. TONON	524
First Test Results with Compass ECRH System P.R. COLLINS, N.R. AINSWORTH, M.W. ALCOCK, P.M. BARNES, A.N. DELLIS, A. HOSKINS and A.C. RIVIERE	529
Technology of Megavolt–Multiampere Negative Ion Beam Acceleration with Application to Iter Neutral Beam Current Drive J.H. WHEALTON, W.R. BECRAFT, W.L. STIRLING, K.E. ROTHE, R.J. RARIDON, B.D. MURPHY, P.S. MESZAROS, H.H. HASELTON, P.M. RYAN, G.E. MCMICHAEL, T.P. WANGLER, A. SCHEMPP, M.A. AKERMAN, G.C. BARBER and W.K. DAGENHART	534
High Voltage Power Source for T-15 Additional Heating V.P. AGALAKOV, N.N. BRITOUSOV, E.B. ISSERLIN, G.M. KOUPERMAN, A.D. PLISS, V.M. ROBINA and S.A. SAVOSTIANOV	547
Heating Systems of Large Superconducting Helical Device T. MUTOH, Y. TAKEIRI, T. OBIKI, F. SANO, A. FUKUYAMA, K. HANATANI, S. KUBO, O. KANEKO, R. KUMAZAWA, Y. NAKAMURA, K. NARIHARA, H. OKADA, M. SATO, T. SHOJI, M. HOSOKAWA, E. KAKO, T. AOKI, T. WATARI, M. OHNISHI, T. KURODA, S. KITAGAWA, K. YAMAZAKI, O. MOTOJIMA, N. OHYABU, M. FUJIWARA and A. IIYOSHI	552
Integration and Operation of the Power Supplies for Neutral Injection at Textor U. SCHWARZ, M. LOCHTER, S. HALTRICH, H.U. BOKSBERGER, N. TOMLJENOVIC and O. GOLL	557
Design and Manufacture of a Target to Protect the Duct between Textor and Neutral Injection H. BECKERS, H. BOUSACK, R. RAMSEYER and H. STÖRI	563
Structural Assessment of a Proposed Upgrade in the JET Pini Grids D.A. HUGHES, R.C. MCLACHLAN and N.A. MITCHELL	568
A High Energy Neutral Beam System for Reactors O.A. ANDERSON, C.F. CHAN, W.S. COOPER, K.N. LEUNG, A.F. LIETZKE, C.H. KIM, W.B. KUNKEL, J.W. KWAN, P. PURGALIS, A.S. SCHLACHTER, L. SOROKA, J.W. STEARNS, R.P. WELLS, R.S. DEVOTO, M.E. FENSTERMACHER, W.B. LINDQUIST, Y. GOHAR, W.S. NEEF, J. BROOK, T. LUZZI, J.A. O'TOOLE, D.W. SEDGLEY, J.H. FINK, K.G. MOSES and J.R. TROW	573

Optimization of D ⁻ Sources for Neutral Beams K.N. LEUNG, S.R. WALTHER and W.B. KUNKEL	577
Alignment of the JET High Power Particle Beams P. MASSMANN, G.H. DESCHAMPS, H.D. FALTER, R.S. HEMSWORTH and A. MEINBERGER	578
Conditioning of the JET Neutral Beam Sources H.D. FALTER, G.H. DESCHAMPS, R.S. HEMSWORTH and P. MASSMANN	583
JET Neutral Beam Species Measurements by Doppler-Shift Spectroscopy G.H. DESCHAMPS, H.D. FALTER, R.S. HEMSWORTH and P. MASSMANN	588
Cryo and Vacuum Systems of the Textor Neutral Beam Injectors and their Inherent Safety Concept H.B. REIMER, E. KUESSEL and H.G. ESSER	593
Negative Ion Formation at a Barium Surface Exposed to an Intense Positive-Hydrogen Ion Beam C.F.A. VAN OS, C. LEGUIJT, A.W. KLEYN and J. LOS	598
Tore Supra Neutral Injection System: Project and Construction P. BAYETTI, R. BECHERER, F. BOTTIGLIONI, C. JACQUOT, F. JEQUIER, M. FUMELLI, P. LOTTE, J. PAMÉLA and Z. SLEDZIEWSKI	604
Operation of the Tore Supra Neutral Beam Injector Prototype with Energy Recovery of the Unneutralized Beam M. FUMELLI, F. JEQUIER and J. PAMÉLA	610
Design of Ion Removal System and Magnetic Shielding for the Asdex-Upgrade Neutral Injection Beam Line S. GOETZ, J. SIELANKO, A. STÄBLER and W. SZYSZKO	615
Design of the Neutral Beam Injection System for Asdex-Upgrade A. STÄBLER, J.-H. FEIST, E. SPETH, J.L. DUNNE, S. GOETZ, B. HEINEMANN, A. KRAUSS, R.-C. KUNZE, H. LOHNERT, J. SIELANKO, W. SZYSZKO, O. VOLLMER and K. WITTENBECHER	620
Initial Operation and Performance of the Asdex Long-Pulse Injection System O. VOLLMER, R. BILAU-FAUST, J.-H. FEIST, K. FREUDENBERGER, S. GÖTZ, R.-C. KUNZE, H. LOHNERT, W. OTT, W. SZYSZKO, E. SPETH, A. STÄBLER and K. WITTENBECHER	625
Compact one Megavolt Power Supply Integrated to a High Power (10 MW) D ⁻ Steady State Accelerator C. JACQUOT	631
First Results of Conditioning the Neutral Beam Ion Sources for TEXTOR R. UHLEMANN, H. EURINGER and M. LOCHTER	636
Ion Bernstein Wave Antenna Design for DIII-D R.D. PHELPS, M.J. MAYBERRY and R.I. PINSKER	642
Development of a Large Plasma Generator with High Proton Yield K. WATANABE, M. ARAKI, M. HANADA, H. HORIIKE, T. INOUE, H. KOJIMA, S. MATSUDA, Y. MATSUDA, Y. OHARA, Y. OKUMURA, S. TANAKA and K. YOKOYAMA	647
Selfconsistent Description of TEXTOR Equilibria Necessary for Enhanced Flux Swing Requirements A. NICOLAI and P. BÖRNER	652
A Fully Integrated Field Coil and Power Supply System for Plasma Boundary Shape and Position Control in Tore Supra J.M. ANE, B. BAREYT, J. BLUM, J.M. BOTTEREAU, P. HERTOUT, C. LELOUP, M. MOUSTIER, F. PARLANGE, A. PANZARELLA and B. THOORIS	657
An Overview of the DIII-D Long Pulse Neutral Beam System R.W. CALLIS, A.P. COLLERAINE, R.-M. HONG, A.R. LANGHORN, R.L. LEE, J. KIM, J.C. PHILLIPS and J.J. WIGHT	662
Analysis of RFX Plasma Equilibrium with Feedback Control F. GNESOTTO, G. MARCHIORI and P. SONATO	668
Advanced Control of the Tokamak Plasma Shape and Position by the Quick Response Power Supply R. SHIMADA, J. HOSODA, M. IIZUKA, Y. MATSUZAKI, T. MATSUKAWA, K. OHMORI, Y. WATANABE and A. OZAKI	674

Electric Power Circuit for Plasma Stabilization in Asdex Upgrade A. WIECZOREK, M. BLAUMOSER, U. SEIDEL, X.L. WANG and W. WOYKE	679
Optimal Selection of Plasma Parameters and Magnetic Measurement Locations for Tokamak Feedback Control P. MCCARTHY, O. KARDAUN, H. BRUHNS and K. LACKNER	687
Analysis of Vertical Instability in the JET Experiment R. ALBANESE, E. BERTOLINI, S. BOBBIO, R. MARTONE, G. MIANO and P. NOLL	694
<i>Section III: Fuel Cycle Engineering</i>	
Experimental Results on Acceleration of D ₂ -Pellets by an Arc-Heated Gas Gun P. MICHELSEN, P. ANDERSEN, S.A. ANDERSEN, L. BAEKMARK, B.H. HANSEN, V.O. JENSEN, H. KOSSEK and K.-V. WEISBERG	700
A Multishot Pellet Injector Design H. SØRENSEN, P. ENGBAEK, A. NORDSKOV, B. SASS, P. VILLORESI and K.-V. WEISBERG	704
Pellet Injector Research at ORNL S.K. COMBS, C.A. FOSTER, S.L. MILORA, D.D. SCHURESKO, M.J. GOUGE, P.W. FISHER, B.E. ARGO, G.C. BARBER, L.R. BAYLOR, M.J. COLE, D.T. FEHLING, C.R. FOUST, F.E. GETHERS, H.H. HASELTON, T.C. JERNIGAN, N.S. PONTE, A.L. QUALLS, D.E. SCHECHTER, D.W. SIMMONS, C.W. SOHNS, D.O. SPARKS, C.C. TSAI and J.C. WHITSON	709
Prototype of a High Speed Pellet Launcher for JET K. SONNENBERG, P. KUPSCHUS, J. HELM, D. FLORY and F. ZACCHIA	715
Diagnostics for the JET Multi-Pellet Injector W. BAILEY, P. KUPSCHUS, M. GADEBERG, T. SZABO, D. CRACKNELL, M.J. ADAMS and B. MILLS	720
Development of Pellet Injector for JT-60 K. KAWASAKI, H. HIRATSUKA, H. TAKATSU, M. SHIMIZU, M. ONOZUKA, T. UCHIKAWA, S. IWAMOTO and N. HASHIRI	724
Development of Fast Opening Magnetic Valve for JT-60 Pellet Injector H. HIRATSUKA, K. KAWASAKI, H. TAKATSU, Y. MIYO, Y. YOSHIOKA, K. OHTA, M. SHIMIZU, M. ONOZUKA, T. UCHIKAWA, S. IWAMOTO and N. HASHIRI	729
Improved Two-Stage Gun for Pellet Injection A. REGGIORI, G. RIVA, G. DAMINELLI, F. SCARAMUZZI and A. FRATTOLILLO	733
New Piezo Driven Gas Inlet Valve for Fusion Experiments E. USSELMANN, J.L. HEMMERICH, J. HOW, D. HOLLAND, J. ORCHARD, T. WINKEL, L. GROBUSCH, U. SCHARGITZ and N. POCHEIM	738
<i>Section IV: First-Wall Engineering and Vacuum Technology</i>	
First Experiment on Erosion Dust Measurement in a Tokamak J. CHARUAU and H. DJERASSI	743
Thermal Analysis of W VII-AS Limiter System and Presentation of a Graphite-Block Concept S. MUKHERJEE and P. GRIGULL	748
Thermal Stability of Chromium Carbide Films and the Stability against Hydrogen Ions T. HINO, T. MIYAZAKI, S. FUKUDA and T. YAMASHINA	754
Comparison in Structure and Property of Carbon Films Produced by Various Plasmas H. MINAGAWA, T. HINO and T. YAMASHINA	759
Design of Thin-Double-Wall Vacuum Vessel with D-Shape Cross Section for JT-60U K. IOKI, F. MATSUOKA, K. NAMIKI, S. NIKURA, K. SHIMIZU, M. TOMITA, M. NISHIKAWA, S. TSUJIMURA, T. UCHIKAWA, K. UE, T. HORIE, H. TAKATSU, H. NINOMIYA and H. HORIIKE	764

Integrated Engineering Design of New In-Vessel Components M.A. PICK, G. CELENTANO, K.J. DIETZ, C. FROGER, L. ROSSI, R. SHAW and L. SONNERUP	771
Full Power Operation at JET: Consequences for In-Vessel Components M.A. PICK, G. CELENTANO, E. DEKSNIS, K.J. DIETZ, C. FROGER, M. HUGON, M. HUGUET, P.H. REBUT, R. SHAW, L. SONNERUP and P. STOTT	776
Cryopumping in the Active (D/T) Phase of JET W. OBERT	781
Conceptual Design of Plasma Exhaust Cryopumping in NET W. OBERT and D. PERINIC	786
First Boronization of Textor - Concept and Realization H.G. ESSER, H.B. REIMER, J. WINTER and D. RINGER	791
High Heat Flux Testing of Plasma Facing Components for Tore Supra C.D. CROESSMANN, J.B. WHITLEY, P. CHAPPUIS, M. LIPA and P. DESCHAMPS	796
Development and Testing of High-Heat-Flux Components for the Tore Supra Horizontal Pump Limiter Module J.A. KOSKI, F.M. HOSKING, R.D. WATSON and C.D. CROESSMANN	803
Engineering Design and Performances of the Ignitor First Wall G. BONIZZONI, M. BROSSA, D. CASALI, U. GUERRESCHI and F. ROSATELLI	809
The New Design for the Coupling Structures in FTU: Technological Problems C. FERRO, A. ORSINI and M. SACCHETTI	814
First Wall for NET: Engineering Studies, Mockup Design and Manufacturing E. FRANCONI, V. RADO, G. SIMBOLOTTI, V. VIOLANTE, V. ZAMPAGLIONE, F. CELEN- TANO, P.G. AVANZINI, M. BROSSA, D. CASALI, M. GRATAROLA, U. GUERRESCHI, F. ROSATELLI and G. VIEDER	819
Design Options for the NET Vacuum Vessel and Its Resistive Elements F. FAUSER, R. ANNANDALE, C. CASCI, D. COLLIER, G. MALAVASI, B. PAVAN, E. SALPI- ETRO, R.M. HARRISON, W. HUGHES, B. GOUTON and S.E. SCHWEIZER	824
Thermal and Mechanical Analysis of the NET Vacuum Vessel D. COLLIER, R. ANNANDALE and F. FISCHER	829
Observation of Divertor Plasma During H- and L-Mode Operation in JFT-2M Tokamak M. HASEGAWA, T. SHOJI, H. OHTSUKA, I. YANAGISAWA, M. MORI, H. MATSUMOTO, N. SUZUKI, S. SENGOKU, K. ODAJIMA, H. TAMAI, Y. MIURA, K. HOSHINO, I. NAKAZAWA, S. KASAI, T. KAWAKAMI, H. KAWASHIMA, T. YAMAMOTO and T. YAMAUCHI	835
Engineering the Divertor Collector Plates for a Demo Reactor V.K. THOMPSON and W.J. WORRAKER	842
Load Peaking at the Net Divertor Due to Design Related Geometrical Imperfections K. KLEEFELDT	848
Testing of Divertor Samples for NET at the JET N.B.I. Test Bed A. CARDELLA, B. LIBIN, M. COULON, D. EVANS, H.D. FALTER, R. FARON, R.S. HEMSWORTH, D. MARTIN, F. MOONS, R. TIVEY and M. VASSILIADIS	854
Divertor Plate Concept with Carbon Based Armour for NET F. MOONS, R. HOWARD, G. KNERINGER and R. STICKLER	859
Divertor Plates with Replaceable Conductively Cooled Carbon Tiles D. BESSON, M. COULON, R. RUAUX, R. FARON, J. ARCHER, D. JUGE, B. LIBIN and F. MOONS	866
Power Flow to the ASDEX Divertor Plates H. WÜRZ, B.K. BEIN, J. NEUHAUSER and D. ZASCHE	867
Mechanical Design and Manufacture of Magnetic Ergodic Divertor for the Tore Supra Tokamak M. LIPA, R. AYMAR, P. DESCHAMPS, P. HERTOUT, C. PORTAFAIX and A. SAMAIN	874

The Tore Supra Pump Limiter System P. CHAPPUIS, R. AYMAR, P. DESCHAMPS, M. GABRIEL, J.B. WHITLEY, J.A. KOSKI, R. MC GRATH and R.D. WATSON	879
Tore Supra Graphite Inner First Wall P. CHAPPUIS, R. AYMAR, P. DESCHAMPS, M. GABRIEL and C.D. CROESSMANN	884
Radiation Enhanced Sublimation of Graphite Bombarded by Low Energy H ⁺ , D ⁺ and He ⁺ Ions in the Range of 50 eV to 6 keV J. BOHDANSKY and J. ROTH	889
In-Vessel Activities and Radioactive Contamination Control During the 1987 TFTR Shutdown G.R. WALTON, D.K. OWENS and G.W. BARNES	894
Author Index	xxxii