



## CONTENTS

Foreword .....	xix
Samuel C. Collins Award .....	xx
Russell B. Scott, Memorial Awards .....	xxi
Student Awards .....	xxii
1995 Cryogenic Engineering Conference Board .....	xxiii
Acknowledgments .....	xxiv

### PART A

#### Cryobiology

ENGINEERING ASPECTS OF CRYOBIOLOGY .....	1
L. Wolfinbarger, Jr., V. Sutherland, L. Braendle and G. Sutherland	
POSSIBLE APPLICATIONS OF DIRECTIONAL SOLIDIFICATION TECHNIQUES IN CRYOBIOLOGY .....	13
I. Heschel, C. Lückge, M. Rödder, C. Garberding and G. Rau	
CRYOGENIC HEAT TRANSFER OPTIMIZATION OF THE FREEZING FRONT GENERATED BY A CRYOPROBE .....	21
V. Zarnescu and F. Chiriac	
ON A LUMPED HEAT TRANSFER MODEL OF FREEZING PROCESS OF CRYOPRESERVATION MEDIA .....	29
D.Y. Gao, J. Liu, F. Kleinhans, A. Ungan and J.K. Critser	
SOME ENGINEERING CONSIDERATIONS IN DESIGNING A MULTIPROBE CRYOSURGICAL DEVICE USING LIQUID NITROGEN .....	37
Z.H. Chang	
PHASE DIAGRAM PREDICTION FOR SOLUTIONS OF INTEREST IN CRYOBIOLOGY .....	47
C.V. Studholme and L.E. McGann	
STANDARDIZED IN VITRO MEASUREMENT OF HEAT FLUX AND DIAMETER OF FROZEN REGION FOR CRYOSURGICAL PROBES .....	55
R. Speetzen, M. Proske, I. Heschel and G. Rau	
TEMPERATURE CONTROL OF A MICROSCOPE FREEZING STAGE FOR THE CRYOPRESERVATION OF LIVING CELLS: COMPARISON OF TWO DIFFERENT CONCEPTS .....	63
Th. Gross, Ch. Roling, I. Heschel, P. Schwindke and G. Rau	
GLASS TRANSITION CURVES OF AQUEOUS SOLUTIONS FOR THE FREEZE-DRYING OF BIOMATERIALS .....	71
G. Spieles, I. Heschel and G. Rau	
DESIGN OF A HIGH-T <sub>c</sub> SQUID BASED HEART SCANNER COOLED BY SMALL STIRLING COOLERS .....	79
H.J.M. ter Brake, H.A. de Boer, W.A.M. Aarnink, H.J. Holland, P.C. Bruins, P.J. van den Bosch and H. Rogalla	
PREDICTION OF THE CHARACTERISTICS OF BIOLOGICAL TISSUE BEING DESTROYED WITH A LOCAL CRYOAFFECTON .....	87
Y.P. Filippov	

## **Heat and Mass Transfer: General**

SUPPLEMENTAL MULTILAYER INSULATION RESEARCH FACILITY .....	95
P.J. Dempsey and R.J. Stochl	
VARIABLE DENSITY MLI TEST RESULTS .....	101
R.J. Stochl, P.J. Dempsey, K.R. Leonard and G.E. McIntosh	
THE EFFECTS OF VIBRATIONS ON THE PERFORMANCE OF PEARLITE VACUUM INSULATION .....	109
L. Xu, A.Z. Gu, R.S. Wang and S.M. Li	
THERMAL CONDUCTIVITY OF POLYURETHANE FOAM AT LIQUID HYDROGEN TEMPERATURE REGION .....	117
M. Yamaguchi, K. Takahashi and T. Ohmori	
THERMAL CONDUCTIVITY OF VACUUM PRESSURE IMPREGNATED Cu AND Al STABILIZED NbTi SUPERCONDUCTING COILS .....	123
J.D. Walters, T.L. Cooper and T.H. Fikse	
THE THERMAL CONDUCTIVITY OF SOME MODERN ENGINEERING MATERIALS USED IN HIGH BANDWIDTH I/O SYSTEMS AT CRYOGENIC TEMPERATURES .....	131
D.L. Patelzick, E.L. Hershberg and T.J. Hendricks	
GAS-GAP THERMAL SWITCH FOR PRECOOLING OF CRYOCOOLER-COOLED SUPERCONDUCTING MAGNETS .....	139
G.R. Chandratilleke, Y. Ohtani, H. Hatakeyama, T. Kuriyama and H. Nakagome	
NITROGEN HEAT PIPE FOR CRYOCOOLER THERMAL SHUNT .....	147
F.C. Prenger, D.D. Hill, D.E. Daney, M.A. Daugherty, G.F. Green and E.W. Roth	
NUMERICAL SIMULATION OF THERMAL STRATIFICATION IN LIQUID HYDROGEN .....	155
Z. Tanyun, H. Zhongping and S. Li	
NUMERICAL SIMULATION OF THERMAL ACOUSTIC OSCILLATIONS IN A LIQUID HELIUM SYSTEM .....	163
Y. Gu and K.D. Timmerhaus	
LOCALIZED HEAT TRANSFER TO VERTICAL FORCED FLOW TWO-PHASE HELIUM .....	173
J. Panek, X. Huang and S.W. Van Sciver	
VACUUM ROUGHING PROCESS FOR LONG CONDUIT WITH LARGE CROSS SECTION ....	179
B.X. Zhang	

## **Heat and Mass Transfer: Boiling**

INFLUENCE OF HEATER ORIENTATION ON FLUCTUATIONS IN STEADY-STATE NUCLEATE BOILING .....	187
W.F. Osborne, E. Bodegom, J.S. Semura and L.C. Brodie	
BOILING ENHANCEMENT BY MICRO GROOVES .....	195
R.F. Barron and M.A. Baig	
INCIPIENT BOILING SUPERHEATS AND CRITICAL HEAT FLUXES DUE TO INCREASING HEAT INPUTS IN SUBCOOLED He I AT VARIOUS PRESSURES .....	203
A. Sakurai, M. Shiotsu and K. Hata	
HEAT TRANSFER FROM ALUMINUM SURFACES TO POOL BOILING He I .....	211
Y. Huang and S.W. Van Sciver	
HEAT TRANSFER FROM AN OXIDIZED LARGE COPPER SURFACE TO LIQUID HELIUM – DEPENDENCE ON SURFACE ORIENTATION AND TREATMENT .....	217
A. Iwamoto, T. Mito, K. Takahata, N. Yanagi and J. Yamamoto	
STUDIES ON A HEAT EXCHANGER PRODUCING SUBCOOLED LIQUID HELIUM.....	225
N. Ohuchi and K. Tsuchiya	

## **Heat and Mass Transfer: Helium II**

SPECIAL PHYSICAL PROBLEMS RELATED TO HEAT TRANSFER IN BATH OF SUPERFLUID HELIUM .....	233
R. Wang	

TRANSIENT HEAT TRANSFER FROM A HORIZONTAL WIRE IN SUBCOOLED He II AT ATMOSPHERIC PRESSURE FOR A WIDE RANGE OF WIRE DIAMETER .....	241
M. Shiotsu, K. Hata and A. Sakurai	
VISUALIZATION STUDY OF HIGHLY TRANSIENT THERMO-FLUID DYNAMIC PHENOMENA IN He II .....	249
T. Iida, M. Murakami, T. Shimazaki, H. Nagai and T. Furukawa	
THERMO-FLUIDDYNAMIC ASPECT OF NOISY FILM BOILING PHENOMENA IN He II .....	257
M. Murakami, Y. Katsuki and M. Yamaguchi	
TEMPERATURE MEASUREMENT IN TRANSIENT HEAT TRANSPORT PHENOMENA THROUGH A THERMAL BOUNDARY LAYER WITH HIGH VORTEX DENSITY IN He II ..	265
T. Shimazaki, M. Murakami and T. Iida	
TRANSITION TO TURBULENT STATE OF SUPERFLUID HELIUM FLOW THROUGH THERMOMECHANICAL PUMP ELEMENT .....	273
H. Nakai, N. Kimura, M. Murakami, T. Haruyama and A. Yamamoto	
THE ASPECT-RATIO EFFECT OF He II CHANNELS ON HEAT TRANSPORT CHARACTERISTICS .....	281
H. Kobayashi, Y. Akedo and K. Kawakami	
STEADY STATE HEAT TRANSFER IN He II THROUGH POROUS SUPERCONDUCTING CABLE INSULATION .....	289
B.J.P. Baudouy, F.-P. Juster, C. Meuris, L. Vieillard and M.X. Francois	
<b>Magnet: Design and Performance</b>	
THERMAL CONDUCTANCE OF HEAT TRANSFER INTERFACES FOR CONDUCTIVELY COOLED SUPERCONDUCTING MAGNETS .....	297
T.L. Cooper, J.D. Walters and T.H. Fikse	
THERMAL DESIGN AND ANALYSIS OF A CRYOGENLESS SUPERCONDUCTING MAGNET FOR INTERVENTIONAL MRI THERAPY .....	305
K.M. Obasih and M.T. Mruzek	
COOLDOWN ANALYSIS OF A CONDUCTION-COOLED SUPERCONDUCTING MAGNET FOR MAGNETIC RESONANCE THERAPY (MRT) .....	313
K.M. Obasih and O.O. Ige	
CRYOGEN-FREE 5T SPLIT-PAIR SUPERCONDUCTING MAGNET WITH A 50 mm DIAMETER X 10 mm ROOM TEMPERATURE GAP .....	319
K. Watanabe, S. Awaji, J. Sakuraba, K. Jikihara, K. Watazawa, T. Hasebe, F. Hata, C.K. Chong, Y. Yamada and M. Ishihara	
TEMPERATURE AND PRESSURE RISE IN SUPERCRITICAL HELIUM DURING THE QUENCH OF INDIRECTLY COOLED SC COILS .....	325
R.M. Schöttler and H.W. Lorenzen	
FINITE ELEMENT CODE FOR QUENCH AND STABILITY ANALYSIS OF SUPERCONDUCTING MAGNETS COOLED BY He II .....	335
M.B. Gorbunov, L. Bottura, J.R. Miller and S.W. Van Sciver	
DESIGN AND PROJECTED PERFORMANCE OF THE WESTINGHOUSE $\mu$ SMES UNIT .....	343
O.R. Christianson, D.J. Hall, D.A. Hoecker, D.W. Scherbarth, R.L. Swensrud, J.M. Toms and D.T. Hackworth	
FABRICATION AND TESTING OF 1-m-LONG SSC MODEL DIPOLE MAGNETS .....	351
K. Hosoyama, K. Hara, N. Higahi, A. Kabe, H. Kawamata, Y. Kojima, Y. Morita, H. Nakai, A. Terashima, T. Takahashi, T. Shintomi, H. Hirabayashi and Y. Kimura	
QUENCH CHARACTERISTICS OF 1-m-LONG SSC MODEL DIPOLE MAGNETS .....	359
K. Hosoyama, A. Kabe, K. Hara, N. Higahi, H. Kawamata, Y. Kojima, Y. Morita, H. Nakai, A. Terashima, T. Takahashi, T. Shintomi, H. Hirabayashi and Y. Kimura	
A SUPERCONDUCTING BENDING MAGNET SYSTEM FOR A COMPACT SYNCHROTRON LIGHT SOURCE .....	367
M.A. Green, A.A. Garren, E.M. Leung, D.D. Madura, D.B. Cline, J.J. Kolonko and L.C. Schachinger	
HIGH GRADIENT, LARGE APERTURE QUADRUPOLES FOR THE NSCL SUPERCONDUCTING SPECTROMETER .....	375
B. Zhang, A.F. Zeller, J.C. DeKamp, P. Johnson, B. Sherrill, R. Swanson and R. Zink	

CRYOGENIC TESTS OF THE g-2 SUPERCONDUCTING SOLENOID MAGNET SYSTEM .....	383
L.X. Jia, J.R. Cullen, Jr., A.J. Esper, R.E. Meier, C. Pai, L. Snydstrup, T. Tallerico and M.A. Green	
MAGNETIC FIELD MEASUREMENT OF SUPERCONDUCTING DIPOLE MAGNETS WITH HARMONIC COIL AND HALL PROBE .....	389
H. Nakai, A. Kabe, Y. Kojima, K. Hara, K. Hosoyama, Y. Morita, T. Shintomi and A. Terashima	
<b>Magnet: Technology and Applications</b>	
NEW CALORIMETRIC AC LOSS MEASUREMENT TECHNIQUE INVOLVING SUPERFLUID HELIUM .....	397
B.J.P. Baudouy, K. Bartholomew and S.W. Van Sciver	
A.C. LOSS MEASUREMENT OF SUPERCONDUCTING DIPOLE MAGNETS BY THE CALORIMETRIC METHOD .....	405
Y. Morita, K. Hara, N. Higashi, K. Hosoyama, A. Kabe, H. Kawamata, Y. Kojima, H. Nakai, T. Shintomi, T. Takahashi and A. Terashima	
HTS COIL AND JOINT DEVELOPMENT FOR A 5T NMR INSERT COIL .....	413
P.V. Shoaff, Jr., J. Schwartz, S.W. Van Sciver and H.W. Weijers	
Bi-2212/Ag TAPE CONDUCTOR AND COIL DEVELOPMENT .....	419
G.W. Albert, R. Zhou, E.M. Leung, K.V. Salazar, T.G. Holesinger, M.D. Daugherty and J.O. Willis	
CONSIDERATION OF USING HTS COILS AS A MAGNET CORE BIAS WINDING .....	427
J.X. Jin, S.X. Dou, R. Bhasale, H.K. Liu, C. Grantham, N. Savvides and M. Ionescu	
QUENCH DEVELOPMENT IN A HIGH TEMPERATURE SUPERCONDUCTING TAPE .....	433
J.W. Lue, M.S. Lubell, D. Aized, J.M. Campbell and R.E. Schwall	
COIL BOBBIN FOR STABLE SUPERCONDUCTING COILS.....	441
T. Kashima, A. Yamanaka, E.S. Yoneda, S. Nishijima and T. Okada	
EFFECT OF INCORPORATING COOLING CHANNELS INTO THE COIL SUPPORT STRUCTURE OF THE TPX TOROIDAL FIELD MAGNET .....	449
Y.M. Lvovsky, G.W. Neeley, W. Tong, K.E. Grut and T.A. Antaya	
SUPPORT SYSTEM DESIGN INCORPORATING CARBON/EPOXY TENSION STRAPS FOR A FOUR TESLA, ONE METER BORE, MRI MAGNET .....	457
L.C. Watts, K. Boullos, K.T. Hartwig and F.R. Huson	
STUDY OF IMPREGNATING EPOXY RESINS FOR HIGH FIELD NMR SUPERCONDUCTING MAGNETS .....	465
G. Liang, G. Luo, L. Crowe, J. Zeigler, G. Shotzman, Y. Wu and R. Teodorescu	
MECHANICAL AND THERMAL PROPERTIES OF SELF-BONDED SUPERCONDUCTING WINDING .....	473
H. Moriyama, H. Mitsui, J. Ohmori, S. Murai, S. Nishijima and T. Okada	
CONSTRUCTION AND TESTING OF A GENERAL PURPOSE 50 LITER LIQUID HELIUM CRYOVESSEL .....	481
J. Schubert, H. Blosser, J. Kim, L. Lee, G. Stork and A. Zeller	
EXPERIENCE ON SHEATHING 10 km OF CABLE-IN-CONDUIT CONDUCTOR FOR THE NHMFL 45-T HYBRID .....	489
J.R. Miller, T.A. Painter, A.L. Devernoe, R.M. Schaedler, G. Grabinsky, J.E.C. Williams and E. Bobrov	
DEVELOPMENT OF BENDING CHARACTERISTICS FOR THE TPX TF MAGNET COIL CABLE-IN-CONDUIT CONDUCTOR .....	497
K.E. Grut, R.L. Holbrook, E. Hook and T.A. Antaya	
RESULTS OF THERMAL HYDRAULIC MEASUREMENTS ON TWO 15 kA ITER STYLE CABLE IN CONDUIT CONDUCTORS .....	505
B. Rousset, J-L. Duchateau, A. Gauthier, A. Martinez, P. Seyfert and J. Weisend II	
PREDICTED THERMAL-HYDRAULIC CHARACTERISTICS OF CABLE-IN-CONDUIT CONDUCTOR WINDINGS DURING STEADY-STATE OPERATION .....	513
T. Kupiszewski, O.R. Christianson and D. Natelson	

TEST FACILITY FOR JOINTS OF SUBSIZE CABLE-IN-CONDUIT CONDUCTORS FOR NET/ITER WINDING STUDIES .....	521
B. Jager, P. Chaussonnet, D. Ciazynski, J.P. Serries and R. Simon	
THERMAL HYDRAULIC CHARACTERISTICS OF A PROTOTYPE CEA CABLE-IN-CONDUIT CONDUCTOR (CICC) .....	529
R. Maekawa, M.R. Smith and S.W. Van Sciver	
COUPLING LOSSES OF FUSION CONDUCTORS: INFLUENCE OF SOME DESIGN PARAMETERS .....	537
J.L. Duchateau, D. Ciazynski, A. Martinez, T. Schild, R. Navatel and H. ten Kate	
TWO-DIMENSIONAL FINITE ELEMENT ANALYSIS OF THE STABILITY OF Ag/BSCCO TAPES .....	545
E.E. Burkhardt and J. Schwartz	
A WAY TO INCREASE THE CRITICAL CURRENT IN THE STAINLESS STEEL JACKETED Nb <sub>3</sub> Sn CONDUCTORS FOR FUSION .....	553
P. Decool, J.L. Duchateau and W. Specking	
<b>Current Leads</b>	
ON THE THERMAL STABILITY LENGTH DEPENDENCE OF HIGH T <sub>c</sub> SUPERCONDUCTORS .....	561
B-Z. Maytal, S. Yang, J. Waldrop and J.M. Pfotenhauer	
OPTIMIZATION OF THE INTERCEPT TEMPERATURE FOR HIGH TEMPERATURE SUPERCONDUCTING CURRENT LEAD .....	567
S. Yang and J.M. Pfotenhauer	
A DESIGN METHOD FOR MULTIPLE TUBE GAS-COOLED ELECTRICAL LEADS FOR THE g-2 SUPERCONDUCTING MAGNETS .....	573
M.A. Green, L.X. Jia, L.J. Addessi, J.R. Cullen, Jr., A.J. Esper and R.E. Meier	
ASSEMBLY AND TESTING OF A COMPOSITE HEAT PIPE THERMAL INTERCEPT FOR HTS CURRENT LEADS .....	579
M.A. Daugherty, D.E. Daney, F.C. Prenger, D.D. Hill, P.M. Williams and H.J. Boenig	
AC LOSS CALCULATIONS FOR HTSC CURRENT LEAD MODULES .....	587
H.P. Kraemer	
DEVELOPMENT OF A 1 kA CLASS ALTERNATING CURRENT LEAD SYSTEM FOR A FAULT CURRENT LIMITER .....	595
M. Takahashi, T. Kuriyama, H. Nakagome, K. Yamamoto, Y. Yamada, M. Nakade, T. Okuma and T. Hara	
LIQUID HELIUM BOIL-OFF MEASUREMENTS OF HEAT LEAKAGE FROM SINTER-FORGED BSCCO CURRENT LEADS UNDER DC AND AC CONDITIONS .....	603
Y.S. Cha, R.C. Niemann, J.R. Hull, C.A. Youngdahl, M.T. Lanagan, M. Nakade and T. Hara	
PERFORMANCE EVALUATION OF HIGH-TEMPERATURE SUPERCONDUCTING CURRENT LEADS FOR MICRO-SMES SYSTEMS .....	611
R.C. Niemann, Y.S. Cha, J.R. Hull, W.E. Buckles, B.R. Weber and S.T. Yang	
PERFORMANCE EVALUATION OF HIGH-TEMPERATURE SUPERCONDUCTING CURRENT LEADS FOR ELECTRIC UTILITY SMES SYSTEMS .....	619
R.C. Niemann, Y.S. Cha, J.R. Hull, C.M. Rey and K.D. Dixon	
TEST OF COPPER-BRAID-STABILIZED BUS LINES FOR SUPERCONDUCTING DIPOLE MAGENTS .....	627
M. Doi, A. Kabe, Y. Kojima, H. Nakai, K. Hara, Y. Morita and K. Hosoyama	
<b>Large Scale Systems</b>	
COMMISSIONING AND OPERATION OF THE CEBAF END STATION REFRIGERATION SYSTEM .....	633
D. Arenius, B. Bevins, W.C. Chronis, V. Ganni, D. Kashy, M. Keesee and J. Wilson, Jr.	
PROCUREMENT AND COMMISSIONING OF THE CHL REFRIGERATOR AT CEBAF .....	641
W.C. Chronis, D.M. Arenius, B.S. Bevins, V. Ganni, D.H. Kashy, M.M. Keesee, T.R. Reid and J.D. Wilson	

THE CEBAF CONTROL SYSTEM FOR THE CHL .....	649
M.S. Keesee and B.S. Bevins	
QUALIFICATIONS AND CRYOGENIC PERFORMANCE OF CRYOMODULE COMPONENTS AT CEBAF .....	655
J. Heckman, K. Macha, J. Fischer, E. Folts, J. Preble and M. Wiseman	
AUTOMATIC PUMPDOWN OF THE 2K COLD COMPRESSORS FOR THE CEBAF CENTRAL HELIUM LIQUEFIER .....	663
B.S. Bevins, W.C. Chronis and M.S. Keesee	
THERMAL PERFORMANCE OF THE CEBAF HALL A CRYOGENIC SYSTEM .....	669
W.J. Schneider, E. Folts, J. Miller, A. Langhorn, M. Morgan and S. Stoy	
CRYOGENIC TESTING AND ANALYSIS ASSOCIATED WITH TEVATRON LOWER TEMPERATURE OPERATION .....	677
J.C. Theilacker	
REFRIGERATED HYDROGEN GAS JET FOR THE FERMILAB ANTIPROTON ACCUMULATOR .....	685
D.H. Allspach, C.L. Kendziora, M. Marinelli, M. Macri, E. Robutti and G. Boero	
INITIAL PERFORMANCE OF UPGRADED TEVATRON CRYOGENIC SYSTEMS .....	693
B.L. Norris	
REQUIREMENTS AND INTERFACES TO CRYOGENIC AND POWER SUPPLY PLANTS FOR THE ITER MAGNET SYSTEM .....	701
K. Yoshida, V. Kalinin, S. Stoner and T. Kato	
CRYOGENIC SYSTEM FOR ITER CS MODEL COIL .....	709
T. Kato, K. Hamada, K. Kawano, T. Hiyama, K. Mastui, K. Nishida, T. Honda, S. Sekiguchi, K. Ootsu, H. Tsuji, S. Shimamoto, K. Okuno, Y. Watanabe, E. Tada, Y. Nakayama and M. Shimoda	
OPERATIONAL EXPERIENCE AND RELIABILITY OF THE CYROGENIC SYSTEMS FOR THE TRISTAN INSERTION QUADRUPOLE MAGNETS .....	719
K. Tsuchiya, N. Ohuchi, Y. Morita, A. Kabe, R. Sugahara and T. Ogitsu	
CONSTRUCTION AND COMMISSIONING TESTS OF A 10 kW CLASS HELIUM REFRIGERATOR FOR THE LARGE HELICAL DEVICE .....	727
S. Satoh, T. Mito, S. Yamada, J. Yamamoto, O. Motojima, S. Moriuchi, I. Ohtake, M. Katada and T. Fukano	
AN EXPERIENCE IN THE MAINTENANCE OF A LIQUEFIER FROM THE T-15 CRYOGENIC SYSTEM, RESULTS OF ITS RELIABILITY AND CAPACITY ENHANCEMENT .....	737
A. Baranov, V. Duzhev, G. Kashirshikh, A. Mikhailov, A. Ugrovatov and V. Zhulkin	
TOKAMAK-15 MODERNIZATION AND AN ANALYSIS OF CRYOGENIC SYSTEM OPERATION FOR THE PERIOD FROM 1988 TO 1994 .....	745
V.E. Duzhev, V.F. Zhulkin, G.M. Kashirshikh and A.E. Ugrovatov	
PERFORMANCE OF THE SUPERCRITICAL HELIUM COOLING LOOP FOR THE JET DIVERTOR CRYOPUMP .....	751
W. Obert, C. Mayaux, K. Barth and L. Herblin	
CONCLUSIONS FROM PROCURING, INSTALLING AND COMMISSIONING SIX LARGE-SCALE HELIUM REFRIGERATORS AT CERN .....	761
M. Barranco-Luque, S. Claudet, W. Erdt, P. Frandsen, Ph. Gayet, D. Güsewell, Ph. Lebrun, J. Schmid, N. Solheim, Ch. Titcomb, U. Wagner and G. Winkler	
R&D OF HIGH RELIABLE REFRIGERATION SYSTEM FOR SUPERCONDUCTING GENERATORS .....	769
T. Hosoya, S. Shindo, H. Yaguchi, T. Ichikawa, K. Tanimoto, M. Kazumori, H. Yanagi and H. Asakura	
<b>Large Hadron Collider - LHC</b>	
THE SUPERFLUID HELIUM CRYOGENIC SYSTEM FOR THE LHC TEST STRING: DESIGN, CONSTRUCTION AND FIRST OPERATION .....	777
A. Bézaguet, J. Casas-Cubillo, B. Flemsaeter, B. Gaillard-Grenadier, Th. Goiffon, H. Guinaudeau, Ph. Lebrun, M. Marquet, L. Serio, A. Suraci, L. Tavian and R. van Weelderen	

MEASUREMENT AND ANALYSIS OF THERMAL PERFORMANCE OF LHC PROTOTYPE CRYOSTATS .....	785
V. Benda, L. Dufay, G. Ferlin, Ph. Lebrun, J-M. Rieubland, G. Riddone, B. Szeless, L. Tavian and L. Williams	
A COMPOSITE VACUUM BARRIER FOR THE LHC SHORT STRAIGHT SECTION .....	793
B. Jenny, P. Rohmig and J-M. Uriarte	
EXPERIMENTAL INVESTIGATION OF ACCIDENTAL LOSS OF INSULATION VACUUM IN AN LHC PROTOTYPE DIPOLE CRYOSTAT .....	799
Ph. Lebrun, B. Szeless, L. Tavian and L.R. Williams	
CRYOGENIC PERFORMANCE OF A SUPERFLUID HELIUM RELIEF VALVE FOR THE LHC SUPERCONDUCTING MAGNETS.....	805
H. Danielsson, G. Ferlin, B. Jenninger, C. Luguet, S-E. Milner and J-M. Rieubland	
MEASUREMENT OF THE THERMO-HYDRAULIC BEHAVIOR OF LHC DIPOLE PROTOTYPES AFTER QUENCH .....	811
G. Gerin, B. Vullierme and R. van Weelderen	
CONCEPTUAL DESIGN OF THE CMS 4 TESLA SOLENOID .....	819
J.C. Lottin, H. Desportes, C. Lesmond, C. Lyraud, C. Pes and A. Hervé	
<b>TeV Electron Superconducting Linear Accelerator - TESLA</b>	
TECHNICAL CHALLENGES OF SUPERCONDUCTIVITY AND CRYOGENICS IN PURSUING TESLA -TTF.....	827
Q.S. Shu	
TESLA TEST FACILITY ALTERNATE CRYOSTAT DESIGN .....	839
T.H. Nicol	
STATUS OF THE TTF CRYOGENIC SYSTEM.....	847
G. Grygiel, U. Knopf, R. Lange, B. Petersen, T. Peterson, D. Sellmann and J. Weisend II	
DESIGN, MANUFACTURE AND TEST OF THE TESLA-TTF CAVITY CRYOSTAT .....	855
F. Alessandria, G. Cavallari, M. Minestrini, T.H. Nicol, C. Pagani, R. Palmieri, S. Tazzari and G. Varisco	
STATUS REPORT OF THE TTF CAPTURE CAVITY CRYOSTAT .....	863
S. Bühler, P. Blache, R. Chevrollier, T. Junquera, N. Colombel, R. Panvier and J. Gastebois	
CRYOSTAT FOR TESTING RF POWER COUPLERS .....	869
M. Kuchnir, M.S. Champion, K.P. Koepke and J.R. Misek	
DESIGN OF POWER AND HOM COUPLERS FOR TESLA .....	877
K. Koepke	
VARIOUS METHODS OF MANUFACTURING SUPERCONDUCTING ACCELERATING CAVITIES .....	885
C. Benvenuti, Ph. Bernard, D. Bloess, E. Chiaveri, C. Hauviller and W. Weingarten	
A NOVEL ROTATING TEMPERATURE AND RADIATION MAPPING SYSTEM IN SUPERFLUID He AND ITS SUCCESSFUL DIAGNOSTICS.....	895
Q.S. Shu, T. Junquera, A. Caruette, G. Deppe, M. Fouaidy, W-D. Moeller, M. Pekeler, D. Proch, D. Renken and C. Stolzenburg	
CRYOGENIC AND ELECTRICAL TEST CRYOSTAT FOR INSTRUMENTED SUPERCONDUCTIVE RF CAVITIES (CHECHIA) .....	905
P. Clay, J.P. Desvard, R. Duthil, J. Gastebois, G. Grygiel, U. Knopf, R. Lange, F. Lejars, C. Mayri, P. Pailler, B. Petersen and D. Sellmann	
THE TESLA 500 CRYOGENIC SYSTEM LAYOUT .....	911
G. Horlitz, T. Peterson and D. Trines	
SAFE AND EFFICIENT OPERATION OF MULTISTAGE COLD COMPRESSOR SYSTEMS .....	921
M. Kauschke, C. Haberstroh and H. Quack	
<b>Mechanisms and Machinery</b>	
DEVELOPMENT OF A NEW GAS-BEARING HELIUM EXPANDER .....	927
E. Thomas	

IMPROVEMENTS IN THE EFFICIENCY OF TURBOEXPANDERS IN CRYOGENIC APPLICATIONS.....	933
R.R. Agahi, M.C. Lin and B. Ershaghi	
HIGH PERFORMANCE CRYOGENIC TURBOEXPANDERS .....	941
R.R. Agahi, B. Ershaghi and M.C. Lin	
EXPERIENCE WITH SMALL TURBOMACHINERY IN A 400 WATT REFRIGERATOR .....	949
J.D. Fuerst	
OPERATION AND MAINTENANCE OF FERMILAB'S SATELLITE REFRIGERATOR EXPANSION ENGINES .....	957
W.M. Soyars	
OPERATION AND MAINTENANCE OF FERMILAB'S 300 kW HELIUM SCREW COMPRESSORS AFTER TWO-MILLION HOURS OF OPERATION .....	965
A. Martinez and C.B. Pallaver	
AN ACTIVE MAGNETIC BEARING WITH HIGH $T_c$ SUPERCONDUCTING COILS AND FERROMAGNETIC CORES .....	973
G.V. Brown, E. DiRusso and A.J. Provenza	
HYBRID SUPERCONDUCTING MAGNETIC BEARING FOR KINETIC ENERGY STORAGE APPLICATIONS AND ITS FRICTIONAL ENERGY LOSS .....	983
Z. Xia, K. Ma, Q. Chen, R. Cooley, P. Fowler and W.K. Chu	
ELECTRONIC HIGH VOLTAGE GENERATOR WITH A HIGH TEMPERATURE SUPERCONDUCTING COIL .....	991
J.X. Jin, C. Grantham, H.K. Liu, M. Apperley and S.X. Dou	
THERMALLY STRESSED ELEMENTS OF CRYO-ALTERNATORS: DEVELOPMENT AND INVESTIGATIONS .....	997
I.S. Ganzhinov and V.A. Tutaev	
SUPERCONDUCTING TURBOGENERATORS AS A NEW GENERATION OF HIGH-RATED ELECTRICAL MACHINES.....	1005
I.A. Glebov and L.I. Chubraeva	
DEVELOPMENT AND EXPERIMENTAL INVESTIGATION OF NEW SEALS FOR CRYOALTERNATORS.....	1011
I.S. Ganzhinov, V.A. Sapozhnikov and V.A. Tutaev	

