CONTENTS

Preface Organization

Research Summaries

Group I: Reactor Materials and Plasma-Wall Interactions

I.1	Fusion reactor materials and plasma-wall interactions1
I.2	Irradiation behaviour of materials under complex conditions and the modelling of the
	behaviour2
I.3	Overall evaluation of graphite as fusion first wall material4
I.4	Development of low activity vanadium-base alloys under fusion reactor environment7
I.5	Irradiation effects in fusion materials by neutrons from experimental fast
	breeder reactors9
I.6	Interactions of tritium beams with various graphite materials11
I.7	Summary report of RTNS-II related researches
I.8	Defect structures and mechanical property of RTNS-II D-T fusion neutron Irradiated
	materials15
I.9	The irradiation effects on the microstructure and properties of reduced
	radio-activation steels17
I.10	Evaluation of radiation damage in ceramics
I.11	Relation between radiation-induced segregation and corrosion resistance in ferritic
	steels
I.12	Development of dynamic tritium trick method
I.13	Hydrogen recycling and radiation damage under heavy bombardments25
I.14	Physical and chemical processes of ion wall-materials interactions in the low energy
	range (below 100 eV)26
I.15	Thermal shock and fatigue properties of coated fusion reactor materials

Group II: Environmental and Biological Effects of Tritium

II.1	The tritium studies in the Japanese fusion program (the steering committee)	31
II.2	Variations of environmental tritium and their interpretation through the analysis	
II.3	Metabolism of tritium and its biomedical effects	
II.4	Transfer of fallout tritium from diet to human body	
II.5	RBE values of β -ray emitted from tritiated water in experimental carcinogenesis	
II.6	Tritium gas exposure systems in medical and biological experiments	41
II.7	Comparison of biological effects of tritium and gamma-rays from a tritium	
	simulator using 137CS sources	43

II.8	In vivo somatic mutation in mice induced by tritium	44
П.9	Effects of tritiated water on various human cells and mice	46
II.10	Radiation effect on nucleic acid induced by tritiated water	48

Group III: Fundamentals of Reactor Plasma Control

III.1	Fundamental research on fusion plasma control (coordinating committee)	.51
III.2	Development of diagnostic techniques of implosion plasma	.55
III.3	Transport and control on RF-heated plasmas	. 59
III.4	Optimization of plasma confinement in external conductor systems	61
III.5	Plasma modelling by computer	63
III.6	Accuracy improvement on neutron diagnostics in magnetic confinement torus	67
III.7	Polarized fuel fusion	. 69
III.8	Focusing of relativistic electron beams with high-Tc superconducting lenses	71
III.9	Generation and measurement of ion beams by a pulsed power generator of an inductive	
	energy storage system	73
III.10	Development of single pulse spectrum analyzer and Schottky diode for plasma	
	diagnostics	75
III.11	Generation of broadband high-power microwaves from an intense relativistic	
	electron beam-plasma system	77
III.12	Physics of the sheet-plasma for negative ion sources	79
III.13	Negative ion production experiments for alpha particle diagnostic beams	81
III.14	Confinement of the plasma in a helical axis system	83
III.15	Measurements of electron energy spectrum and confinement on RFP plasma	85
III.16	Neutral beam injection into FRC plasma	87
III.17	Joule heating of spheromak plasma	89
III.18	Control of plasma current waveform in reversed field pinch	91
III.19	Theory of elementary processes related to fusion research	93

Group IV: Superconducting Magnets

IV.1	Basic research of superconducting magnets for nuclear fusion	95
IV.2	Development and evaluation of advanced fusion magnet materials	97
IV.3	New method of stabilization for high-current density superconducting magnet	99
IV.4	Development of advanced A15 type superconducting wires for high field magnets	101
IV.5	Mechanical properties of structural materials for superconducting magnets	103
IV.6	Improvement of flux pinning characteristics in A15 compound superconductors	105
IV.7	A comprehensive study on flow and heat transfer in the cooling of superconducting	
	magnets	107

IV.8	Effect of sliding friction on the quench in a superconducting magnet	109
IV.9	Electromagneto-fracture mechanics approach on structural integrity assessment	
	system of super-conducting magnet for fusion reactor	110
IV.10	Monitoring and diagnosis of superconducting magnets using ultrasonic wave	112
IV.11	Development of high current density superconducting magnet cooled by indirect	
	cooling method	114

Group V: Fusion Reactor Blanket Engineering

V. 1	Promotion of fusion reactor blanket engineering	117
V.2	Magneto-hydro-dynamic, thermal and structural studies on liquid metal lithium	
	cooling of fusion reactors	119
V.3	Venchmark experiments on neutron and induced gamma-ray transmission and	
	development of calculational methods	. 121
V.4	Prediction of long-term creep curves under service condition of nuclear fusion	
	reactor	123
V.5	Heat transfer characteristics of sodium mist cooling on a hot surface	125
V.6	Evaluations of thermal shock resistances and fracture toughnesses of graphites and	
	C/C-composites as plasma-facing first wall components for fusion reactor devices	127
V .7	Development of flaw diagnostic system for a fusion reactor graphite first wall	129
V.8	First wall behavior under disruption load	131
V.9	Inelastic constitutive relationship of first wall material under multiaxial stress state	133
V.10	Blanket cooling by use of gas/solid suspension medium	135
V.11	Fracture strength of the first wall material in elevated temperature high-temperature-	
	strength of TiC-coated SUS316 stainless steel	137
V.12	Breeding and recovery of tritium in CTR blanket	139
V.13	Tritium separation by powder sintered nickel alloy plate	141
V.14	Storage-supply-recovery of tritium in tritium breeding systems	143
V.15	Measurement of short-lived activation cross sections for fusion reactor material	
	elements	145
V.16	Influence of neutron spectrum on DT- and fast neutron capture gamma-ray profile	146

Group VI: Design and Evaluation of Fusion Reactor

VI.1	Design and evaluation of fusion reactors (steering committee)	149
VI.2	Permeation and impurities of plasma-state tritium	150
VI.3	Plasma production and conditioning technology in Heliotron-E, Gamma-10 and	
	Gekko-XII facilities (collaboration with established small groups)	152

VI.4	Three-dimensional fracture mechanics and evaluation of first wall under elec	
	tromagnetic and thermal shock loading	154
VI.5	Knowledge acquisition for induction of service condition on the basis of materials	
	databases	156
VI.6	Development of databases of research results supplemented by the grant in aid for	
	fusion research	158
VI.7	Design of nonequilibrium MHD generator for compact fusion advanced Rankine	
	cycle	160
VI.8	Quick replacement technology for high power density fusion reactor	162
VI.9	Estimation of tritium inventory in first wall material	164
VI.10	Sorption and decontamination of tritium on surface of piping materials for fusion	
	reactor	165
VI.11	Process valuation of functional materials for plasma exhaust treatment	167