

Contents

Preface

Abbreviation

Executive Summary of the report

Chapter

Page No.

1. Introduction	1
1.1 Introduction to Cryogenics & Superconductivity	
1.2 Liquefied Gases	
1.3 Basic Principles of Liquefaction	
1.4 How Low the temperature can go?	
1.5 Application of Cryogenics	
1.6 Objective of this Report	
1.7 Methodology Adopted to Collect Information	
2. Cryogenics in India	9
2.1 Brief History of Cryogenics / Superconductivity in India	
2.2 DST, the Prime Mover of Cryogenics in India	
2.3 Human Resource in Cryogenics	
2.4 Indian Cryogenics Council	
3. Executive Summary of the Institutes and Industries Engaged in Cryogenics / Superconductivity / Low Temperature Physics	15
3.1 Institutes	
3.2 Public Sector Enterprises	
3.3 Manufacturing Industry	
3.4 Suppliers and services	
4. Major Research Institutions in Cryogenics and Superconductivity	23
4.1 National Physical Laboratory (NPL), New Delhi	
4.2 Indian Association for the Cultivation of Sciences (IACS), Kolkata	
4.3 Tata Institute of Fundamental Research (TIFR), Mumbai	
4.5 Indian Institute of Science (IISc), Bangalore	
4.6 Indian Institute of Technology (IIT), Madras	
4.7 Indian Institute of Technology (IIT), Kharagpur	
4.8 Indian Institute of Technology (IIT), Bombay	
4.9 Bhabha Atomic Research Centre (BARC), Mumbai	

4.10	UGC-DAE Consortium of Scientific Research (UD CSR), Indore	
4.11	Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam	
4.12	Indian Institute of Technology (IIT), Kanpur	
4.13	Saha Institute for Nuclear Physics (SINP), Kolkata	
4.14	Variable Energy Cyclotron Centre (VECC), Kolkata	
4.15	Inter-University Accelerator Centre (IUAC), New Delhi	
4.16	Institute for Plasma Research (IPR), Gandhinagar	
4.17	Indian Space Research Organization (ISRO), Bangalore	
4.18	Raja Ramanna Centre for Advance Technology (RRCAT), Indore	
5.	Analysis of Institute / Industry Activity	41
5.1	Overall Statistics	
5.2	Organization-wise Institute Break-up	
5.3	Activity-wise Institute Break-up	
5.4	Break-up with reference to no. of Personnel in this Field	
6.	Major Facilities related to Cryogenics and Superconductivity available	43
6.1	Helium Liquefaction Facility (Old and New) in India	
6.2	New Plants Installed Recently or to be Installed Shortly	
6.3	Installed Liquid Nitrogen Plants in the Institutes	
6.4	Low Temperature Measurement Systems (PPMS, VSM, MPMS)	
7.	Information on Activities in Major Institute	63
7.1	Cryo Engineering / Technology, Cryo Component Development	
7.2	Institutes Engaged in Basic Research at Low Temperature and Superconductivity	
7.3	Institutes with major Development Programmes in this Field	
8.	Major Projects Funded by Government Agencies	67
8.1	National Superconductivity Programme (NSP)	
8.2	Projects other than NSP	
9.	Cryogenics in gas Industries	73
9.1	History and Present Status	
9.2	AIIGMA	
9.3	Estimated Installed Capacity of O ₂ / N ₂	
9.4	List of Cryogenic Gas Industries	
10.	Cryogenics in Chemistry and Medicines	83
10.1	NMR	
10.2	MRI	

11. Cryo Preservation / Cryo Treatment	91
11.1 Cryo Preservation in Animal Husbandry	
11.2 Human Blood Preservation	
11.3 Stem Cell and cord Cell Preservation	
11.4 Human Semen Preservation	
11.5 Cryo Pulverising / Cryo Grinding	
11.6 Cryo Treatment of Tools	
11.7 Cryo Surgery	
12. Education in Cryogenic Engineering	105
13. Human Resource	107
13.1 In Research Institutions / IITs and Universities.	
13.2 In Space Programme	
13.3 Persons from Industries Interacting with Research Institutes	
13.4 M.Tech. (Cryo. Engg.) Students from IIT, Kharagpur	
13.5 Personnel with Ph.D. in Cryogenics.	
13.6 Students with M.Tech. in Cryo. Engg.	
13.7 Retired Scientists / Professors and Engineers	
13.8 Indians Working Abroad in Cryogenics/ superconductivity	
13.9 Human Resource Statistics in Graphical form	
14. Conclusions and Recommendations	133
15. Annexures	137
15.1 Contact Persons in Institutes/industry	139
15.2 Local Programme Advisory Committee (LPAC)	145
15.3 Leaflet circulated among Cryogenic Community	146