

**超電導エネルギー貯蔵研究会**

**SMES関連論文情報  
(平成27年度版)**

**平成28年7月**

**技術委員会**

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## 1. 調査範囲

データベースに入力する情報は、以下の調査範囲を基本として調査・収集する。

- ① 海外情報を基本とする。但し、トピックス的な情報については国内のものも調査する。
- ② 超電導全般について調査をするが、SME Sあるいは現在開発中のプロジェクト関連の情報に重点を置く。
- ③ 上記以外については、研究開発の現状、動向あるいは政府の施策などが分かるもの、集約されたものを収集する(例えば、材料でチャンピオンデータ等が整理されているものなど)。
- ④ 特許関連については対象外とする。

## 2. 調査項目

データベースからの検索、データの利用を考えて、情報は以下の8項目について整理する。

- ① 国名
- ② 情報の種類、内容(3分類)

分類1 (情報分類)	分類2 (用途)	分類3 (要素技術)
1 : 技術論文 2 : 技術解説・展望 3 : 研究開発動向 4 : 企業動向 5 : 政府・団体・学会動向	1 : 電力貯蔵 2 : 出力設備 3 : 輸送設備 4 : 核融合・MHD・加速器・医療等 5 : デバイス 6 : 材料・製法 7 : 超電導全般	1 : コイル 2 : 断熱支持 3 : He、真空容器 4 : 冷却システム 5 : 電力変換システム 6 : 土木構造 7 : 磁気シールド 8 : ケーブル、導線 9 : 計測、制御 10 : 経済性 11 : その他

- ③ 著者
- ④ タイトル
- ⑤ 出典
- ⑥ 発行年月日
- ⑦ 掲載ページ
- ⑧ 概要

## 3. 調査対象

- (1) 平成26～28年に発行された国際会議の論文
- (2) 国内外の主要学会誌
- (3) 政府関連の報告書
- (4) 企業、大学の刊行物
- (5) その他

#### 4. 入力件数

過去及び本年度の入力数は下記の通り。

	外国情報	国内情報	計
平成2年度	195	158	353
平成3年度	191	96	287
平成4年度	138	24	162
平成5年度	94	58	152
平成6年度	121	77	198
平成7年度	81	11	92
平成8年度	77	129	206
平成9年度	72	47	119
平成10年度	13	47	60
平成11年度	16	44	60
平成12年度	20	37	57
平成13年度	2	25	27
平成14年度	1	14	15
平成15年度	0	11	11
平成16年度	4	13	17
平成17年度	9	42	51
平成18年度	6	39	45
平成19年度	25	23	48
平成20年度	45	15	60
平成21年度	30	9	39
平成22年度	46	12	58
平成23年度	32	10	42
平成24年度	45	18	63
平成25年度	18	8	26
平成26年度	16	6	22
平成27年度	30	7	37
合計	1327	980	2307

## 出力一覧

□平成27年度入力分  
No.2271 ～ 2307  
全項目について出力

整理番号 2271 中国

分類1 1 1 5

著者 Jian Xun Jin, Xiao Yuan Chen, Liang Wen, Shan Chuan Wang, and Ying Xin

タイトル Cryogenic Power Conversion for SMES Application in a Liquid Hydrogen Powered Fuel Cell Electric Vehicle

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 25, NO. 1

発行年 2015 PAGE. 5700111

概要 Cryogenic power conversion for superconducting magnetic energy storage (SMES) application in a liquid hydrogen (LH<sub>2</sub>) powered fuel cell electric vehicle (FCEV) is investigated. Principle and operation strategy of the SMES-based onboard energy system are presented for various operational models. A typical FCEV system equipped with a 720-kJ SMES device is conceptually designed and theoretically modeled with a bridge-type cryogenic chopper, which consists of four metal-oxide-semiconductor field-effect transistors (MOSFETs) cooled by low-temperature gas hydrogen (GH<sub>2</sub>). The bridge-type cryogenic chopper has

整理番号 2272 米国

分類1 1 1 11

著者 Charles C. Rong, Paul N. Barnes, George A. Levin, Jason D. Miller, Daniel J. Santosusso, and Brian K. Fitzpatrick

タイトル Investigation of the Relaxation of Persistent Current in Superconducting Closed Loops Made Out of YBCO Coated Conductors

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 25, NO. 3

発行年 2015 PAGE. 8200805

概要 Coated conductors allow the fabrication of closed superconducting loops of arbitrary size. Various mechanisms can play a role in the decay of a persistent current in one such loop and in an assembly of multiple loops magnetically coupled with each other. We report recent experimental results on the relaxation rate of the persistent current in an assembly of closed superconducting loops made out of the currently manufactured coated conductors. One of the main goals of this study is to find the effective ways to control the relaxation rate so as to make it small enough to enable such high temperature persistent magnets to be

整理番号 2273 中国

分類1 1 1 11

著者 Li Ren, Ying Xu, Wenping Zuo, Xiaohan Shi, Fengshun Jiao, Yang Liu, Jiayi Deng, Jingdong Li, Jing Shi, Shaorong Wang, Yuejin Tang, Jinyu Wen, Peng Han, Qingyun Qu, Huajun Liu, Jinglin Chen, Qing He, Tao Jin, and Shiping Zhou

タイトル Development of a Movable HTS SMES System

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 25, NO. 4

発行年 2015 PAGE. 5701109

概要 A 600-V/150-kJ/100-kW conduction-cooled hightemperature superconducting (HTS) magnetic energy storage (SMES) system is developed. In this paper, the configuration of the HTS SMES is introduced. The magnet is a solenoid type, which uses two kinds of HTS tapes, and cooled to about 20 K. A series of laboratory experiments and field tests are carried out to evaluate the performance of the SMES system, including the current-carrying ability of a magnet, the active and reactive power exchange capability between the SMES and an alternating-current power system, power oscillation damping, the improving

整理番号	2274	米国
分類1	1	1 11
著者	Ivo K. Dimitrov, Xiao Zhang, Vyacheslav F. Solovyov, Oleg Chubar, and Qiang Li	
タイトル	Rapid and Semi-analytical Design and Simulation of a Toroidal Magnet Made With YBCO and MgB2 Superconductors	
出典	IEEE TRANS. APPL. SUPERCOND., VOL. 25, NO. 5	
発行年	2015	PAGE. 5701208
概要	Recent advances in second-generation (YBCO) high-temperature superconducting wire could potentially enable the design of super high performance energy storage devices that combine the high energy density of chemical storage with the high power of superconducting magnetic storage. However, the high aspect ratio and the considerable filament size of these wires require the concomitant development of dedicated optimization methods that account for the critical current density in type-II superconductors. Here, we report on the novel application and results of a CPU-efficient semianalytical computer code based on the Radia 3-D magnetostatics software package. Our algorithm is used to simulate and	
整理番号	2275	中国
分類1	1	1 11
著者	Yang Liu, Student Yuejin Tang, Ying Xu, Jing Shi, Xiaohan Shi, ZuoshuaiWang, Jiaxi Deng, Li Ren, and Sinian Yan	
タイトル	Status Evaluation Method for SMES Used in Power Grid	
出典	IEEE TRANS. APPL. SUPERCOND., VOL. 25, NO. 5	
発行年	2015	PAGE. 5701310
概要	Superconducting magnetic energy storage (SMES) is expected to be utilized in the power grid for dynamic power compensation. However, a SMES status such as magnet current (including parameters of power conditioning system) and temperature of superconducting (SC) magnet will restrict the output capability of SMES. This paper proposes a new method to evaluate SMES status, which will guarantee the dynamic thermal stability of SC magnet applied in power grid. First, it is generally analyzed that the output capability (Pmax) of a SMES is restricted by the initial (standby) current (I0) in the SC magnet for a specific application of SMES. To prove that Pmax also depends on the temperature (T0) of the SC	
整理番号	2276	米国/ベルギー
分類1	1	1 1
著者	Alexey L. Radovinsky, Leslie Bromberg, Joseph V. Minervini, Philip C. Michael, Thomas Servais, Eric Forton, and Emma Pearson	
タイトル	Constant Field Toroidal SMES Magnet	
出典	IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 3	
発行年	2016	PAGE. 5700104
概要	The Massachusetts Institute of Technology has been performing a preliminary study of superconducting magnetic energy storage (SMES) magnet configurations under a Pôle MecaTech Cluster collaboration sponsored by the government of the Walloon Region in Belgium. Consortium members include Ion Beam Applications S.A. (IBA), CE+T Power (CE+T), Euro-Diesel S.A. (Euro-Diesel), Jema S.A. (JEMA), the University of Liege (ULG), the Catholic University of Louvain-la-Neuve (UCL), and the Liege Space Center (CSL). The goal of the project was to assess the commercial feasibility of various SMES magnet configurations by evaluating specific energy, magnetic field shielding properties, and manufacturing cost.	

整理番号 2277 米国

分類1 1 1 1

著者 R. Gupta, M. Anerella, P. Joshi, J. Higgins, S. Lalitha, W. Sampson, J. Schmalzle, and P. Wanderer

タイトル Design, Construction, and Testing of a Large-Aperture High-Field HTS SMES Coil

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 4

発行年 2016 PAGE. 5700208

概要 This paper presents the design, construction, and test results of a high-energy-density coil for a superconducting magnetic energy storage system (SMES). The coil was designed to reach 25 T at 4 K in a 100-mm bore under a program funded by ARPA-E. The coil used over 6 km of 12-mm-wide second-generation high-temperature superconductors (HTS) provided by SuperPower. Such high fields and large aperture in a coil built with a new and still-developing conductor and magnet technology created several challenges, which included large stresses and quench protection. This paper summarizes an ambitious research program that resulted in an SMES coil reaching 12.5 T at 27 K. This is the first

整理番号 2278 韓国

分類1 1 1 9

著者 Thai-Thanh Nguyen, Hyeong-Jun Yoo, and Hak-Man Kim

タイトル Applying Model Predictive Control to SMES System in Microgrids for Eddy Current Losses Reduction

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 4

発行年 2016 PAGE. 5400405

概要 This paper presents a model predictive control for the superconducting magnetic energy storage (MPC-based SMES) system, which can be applied to a voltage source converter and a dc/dc chopper in the SMES system together. The SMES system is implemented in a microgrid to control the constant power flow at the point of common coupling, frequency, and voltage of microgrid. The control performance of the MPC-based SMES system is compared with that of the proportional-integral (PI) control method. The harmonics involved in dc current for the superconducting coil are analyzed to estimate the reduction of the eddy current losses compared to PI technique. The efficacy of the proposed control

整理番号 2279 英国

分類1 1 1 11

著者 Jianwei Li, Min Zhang, Qingqing Yang, Zhenyu Zhang, and Weijia Yuan

タイトル SMES/Battery Hybrid Energy Storage System for Electric Buses

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 4

発行年 2016 PAGE. 5700305

概要 This paper proposes a novel use of superconducting magnetic energy storage (SMES) hybridized with the battery into the electric bus (EB) with the benefit of extending battery lifetime. A new power control algorithm, which integrates a power grading strategy with the filtration control method, is introduced in this paper, achieving further improvement of battery lifetime. To demonstrate the performance of the SMES/battery hybrid energy storage system (HESS), a dynamic EB system is described with the advantage of considering more factors into the driving patterns. Simulation results show that the proposed HESS has successfully combined the SMES with the battery forming an optimal system that

整理番号 2280 中国

分類1 1 1 1

著者 Huiming Zhang, Min Zhang, Jiahui Zhu, Zhenyu Zhang, and Weijia Yuan

タイトル Study of 2G HTS Superconducting Coils Using Line Front Track Approximation

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 3

発行年 2016 PAGE. 4901104

概要 This paper demonstrates an efficient method to calculate the ac losses in multipancake coils. We use the front track line to analyze stacked pancakes by assuming that the current fronts are straight lines and using the critical state model. The current distribution is solved by minimization of total magnetic energy. The calculated ac loss results are compared with the wellaccepted H-formula in COMSOL. We further apply this model to the design of a SMES with 2 kJ, which is under construction. The object of the design is to maximize the stored energy and decrease the ac loss. We discuss the detailed geometry parameters and operation temperature with the validated numerical model. Our model provides a fast

整理番号 2281 ドイツ

分類1 1 1 1

著者 Frank Hornung, Marion Klaeser, Pauline Leys, and Theo Schneider

タイトル Construction and Test of MgB<sub>2</sub> Mock-Up Coils for LIQHYSMES

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 4

発行年 2016 PAGE. 5700405

概要 One of the major challenges that come with an increasing contribution of renewable energies is the storage of the produced energy to balance the temporal fluctuations of power generation and consumption. Therefore, a novel multifunctional hybrid energy storage concept, i.e., LIQHYSMES, has recently been proposed. LIQHYSMES combines the advantages of the energy carrier LIQHYSMES (LH<sub>2</sub>) and the Superconducting Magnetic Energy Storage (SMES). With its critical temperature of 39 K, magnesium diboride (MgB<sub>2</sub>) is a promising superconductor for this application. In this paper, we report on the construction and test of the first demonstrator LIQHYSMES solenoid mock-up coils made of MgB<sub>2</sub>.

整理番号 2282 韓国

分類1 1 1 1

著者 Jinsub Kim, Seokho Nam, Haeryong Jeon, Junseong Kim, Jae Young Jang, and Tae Kuk Ko

タイトル Experimental Analysis on AC Loss and Fault Current Test of HTS Coils Co-Wound With Various Inserted Materials

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 4

発行年 2016 PAGE. 8201605

概要 A significant number of recent studies have explored the impact of many kinds of winding insulation conditions on high-temperature superconducting (HTS) coils for the application of electric devices. HTS coil co-wound with turn-to-turn inserted materials could be an appropriate alternative to the no-insulation coil because of the poor charge-discharge delay and unexpected quench behavior of the no-insulation coil. In addition, the cowound HTS coil has good thermal stability and mechanical integrity, making it useful for superconducting applications such as superconducting magnetic energy storage (SMES) and superconducting fault current limiter (SFCL). However, studies of the co-wound HTS coil

整理番号 2283 中国

分類1 1 1 1

著者 Ying Xu, Yuejin Tang, Li Ren, Qi Dai, Chen Xu, ZhuangWang, Jing Shi, Jingdong Li, Siyuan Liang, and Sinian Yan

タイトル Numerical Simulation and Experimental Validation of a Cooling Process in a 150-kJ SMES Magnet

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 6

発行年 2016 PAGE. 5700507

概要 The Superconducting Magnetic Energy Storage (SMES) system is expected to keep the power balance and increase the stability in an electric power system. During operation, heat may be dynamically generated in the superconducting magnet when the SMES system exchanges energy with the electric grid due to ac losses in superconductors and eddy losses in metal parts. To design a suitable cooling system for an SMES system, it is necessary to find out the heat transfer process from a superconducting magnet to a cryorefrigerator. This paper presents a model to analyze the heat transfer in a 150-kJ/100-kW conduction-cooled high-temperature superconducting (HTS) SMES system. The

整理番号 2284 中国

分類1 1 1 1

著者 Jing Shi, Aobo Zhou, Yang Liu, Li Ren, Yuejin Tang, and Jingdong Li

タイトル Voltage Distribution Characteristic of HTS SMES Magnet

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 4

発行年 2016 PAGE. 5700705

概要 HTS superconducting magnetic energy storage (SMES) system can be utilized to ensure stable operation and high-quality power supply in power systems. In SMES system, the power conditioning system (PCS) interfaces the superconducting magnet and the ac system, controlling the active and reactive power flow. Due to high-frequency switching of the PCS, the voltage distribution on the HTS magnet will affect the magnet insulation and quench detection. Considering the interaction between the PCS and the magnet, the output characteristics of the voltage-source-type and current-source-type PCSs are analyzed. Subsequently, the transient model of magnet is deduced to analyze the voltage distribution on the HTS

整理番号 2285 日本

分類1 1 1 1

著者 T. Yagai, Y. Kimura, H. Kamada, S. Nomura, T. Nakamura, H. Tsutsui, H. Yoshida, M. Kudo, H. Chikaraishi, N. Yanagi, and S. Imagawa

タイトル Strain Distribution of Complex-Bending YBCO Tape in Force-Balanced Coil Applied to SMES

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 4

発行年 2016 PAGE. 8401905

概要 High-temperature superconductor power applications are still expected to be the main players in reducing carbon footprints. In superconducting magnetic energy storage, increasing the stored energy also increases the electromagnetic force, which generally requires heavier support structure. In terms of the force applied to conductors, it causes the extra bending and/or torsional strain of the REBCO tapes. To minimize the applied stress and to reduce the amount of electromagnetic force support structures, a force-balanced coil (FBC) that has a helical-like structure has been proposed. In this type of magnets, the superconducting thin tape experiences complex strains that come from flatwise and edgewise

整理番号 2286 日本

分類1 1 1 4

著者 Y. Makida, T. Shintomi, T. Hamajima, N. Ota, M. Katsura, K. Ando, T. Takao, M. Tsuda, D. Miyagi, H. Tsujigami, S. Fujikawa, J. Hirose, K. Iwaki and T. Komagome

タイトル Performance of a 10-kJ SMES model cooled by liquid hydrogen thermo-siphon flow for ASPCS study

出典 IOP Conf. Series: Materials Science and Engineering 101

発行年 2015 PAGE. 012028

概要 We propose a new electrical power storage and stabilization system, called an Advanced Superconducting Power Conditioning System (ASPCS), which consists of superconducting magnetic energy storage (SMES) and hydrogen energy storage, converged on a liquid hydrogen station for fuel cell vehicles. A small 10- kJ SMES system, in which a BSCCO coil cooled by liquid hydrogen was installed, was developed to create an experimental model of an ASPCS. The SMES coil is conductively cooled by liquid hydrogen flow through a thermo-siphon line under a liquid hydrogen buffer tank. After fabrication of the system, cool- down tests were carried out using liquid hydrogen. The SMES coil was successfully

整理番号 2287 ドイツ

分類1 1 1 4

著者 F Brighenti, R Ramalingam and H Neumann

タイトル A conceptual study on the use of a regenerator in a hybrid energy storage unit (LIQHYSMES)

出典 IOP Conf. Series: Materials Science and Engineering 101

発行年 2015 PAGE. 012087

概要 Wind and photovoltaic parks raise the issue of a discontinuous electrical generation. As an energy carrier with high volumetric energy density, liquid hydrogen is an inevitable choice for large-scale energy storage. But, since balancing loads or rapidly evolving fluctuations on the grid with just hydrogen is unrealistic due to its slow response, it is necessary to integrate it with an electrical energy storage device that enables rapid response. This approach combines the use of a liquefaction plant for hydrogen, and a superconducting magnetic energy storage (SMES). Besides, in this case, conventional liquefaction methods are not a viable solution, meaning that a substantial simplification of the process is possible

整理番号 2288 韓国

分類1 1 1 1

著者 Hyungjun Kim, Jinsub Kim, Jeyull Lee and Tae Kuk Ko

タイトル HTS coil with enhanced thermal stability in over-current operation for fast response magnet power application

出典 Supercond. Sci. Technol. 28

発行年 2015 PAGE. 105006

概要 This paper examines the effect of improved winding geometry on high-temperature superconducting (HTS) coils for use in superconducting power applications. One of the most important functions in such a superconducting magnetic energy storage system is to charge-discharge the superconducting coils as fast as possible to secure sufficient power demand. The HTS coils are vulnerable to the thermal instability caused by cyclic and/or unexpected charge-discharge variation. Therefore, it is necessary to enhance the safety of the HTS coils under fast response operation at the request of varying loads. In this study, improved thermal stability in over-current operation is demonstrated by implementing the

整理番号 2289 イタリア

分類1 1 1 1

著者 Antonio Morandi, Babak Gholizad and Massimo Fabbri

タイトル Design and performance of a 1MW-5s high temperature superconductor magnetic energy storage system

出典 Supercond. Sci. Technol. 29

発行年 2014 PAGE. 015014

概要 The feasibility of a 1 MW-5 s superconducting magnetic energy storage (SMES) system based on state-of-the-art high-temperature superconductor (HTS) materials is investigated in detail. Both YBCO coated conductors and MgB2 are considered. A procedure for the electromagnetic design of the coil is introduced and the final layout is arrived at and compared for the two materials. The choice of the inductance of the coil is carried out as part of the design procedure. Both low-field (3 T) and high-field (8 T) designs are considered for the YBCO. AC losses during a complete charge/discharge cycle at full power are estimated and the cooling power needed for continuous operation is derived. The power

整理番号 2290 中国

分類1 1 1 4

著者 Ying Xu, Yuejin Tang, Li Ren, Qi Dai, Jing Shi, Jingdong Li, Yang Liu, Jiayi Deng, Shiping Zhou, Tao Jin, Qing He

タイトル An evaluation method for small-scale conduction cooled SMES cryogenic cooling system based on thermal analysis

出典 Cryogenics 71

発行年 2015 PAGE. 30-38

概要 The current flowing through a SMES is subjected to variations at a rate ranging from 0.1 A/s to 300 A/s under the influence of the power grid. The duration of power exchange varies from milliseconds to minutes, even to hours. When operating, the impact of AC losses in HTS tapes on the cryogenic cooling system should be considered. If the cryogenic cooling system fails to take away the generated heat effectively, this may lead to the temperature rise of the magnet and its possible damage. Therefore, it is essential to evaluate the technical and economical characteristic of cryogenic cooling system. Thus, a 5 MJ SMES model is built to calculate the temperature characteristic. A new factor  $d$  is defined to assess

整理番号 2291 中国

分類1 1 1 5

著者 Jianwei Li, Min Zhang, Jiahui Zhu, Qingqing Yang, Zhenyu Zhang, Weijia Yuan

タイトル Analysis of Superconducting Magnetic Energy Storage Used in A Submarine HVAC Cable Based Offshore Wind System

出典 Energy Procedia 75

発行年 2015 PAGE. 691 - 696

概要 Because of the booming development of offshore wind power around the world, a stable transmission system which is used for the connection between the offshore wind farms and the onshore grid is required. For the offshore wind farms not far from the coast, high voltage alternating current (HVAC) transmission system is the best choice. Aiming to study the transient problems caused by cable operation, a 60km submarine cable is modeled in this paper using ATP-EMTP. The larger capacitance effect of HVAC submarine cables will cause more severe transient problems. Also, the variable wind power generated by offshore wind farm will bring undesired impact on the onshore power grid. This paper

整理番号 2292 中国

分類1 1 1 9

著者  
Xinpu Wang, JunYang, Xiaodong Zhang, Xiaopeng Yu

タイトル  
An Action Dependent Heuristic Dynamic Programming-Controlled Superconducting Magnetic Energy Storage for Transient Stability Augmentation

出典  
Physics Procedia 65

発行年 2015 PAGE. 286 – 290

概要  
To enhance the stability of power system, the active power and reactive power can be absorbed from or released to Superconducting magnetic energy storage (SMES) unit according to system power requirements. This paper proposes a control strategy based on action dependent heuristic dynamic programming (ADHDP) which can control SMES to improve the stability of electric power system with on-line learning ability. Based on back propagation (BP) neural network, ADHDP approximates the optimal control solution of nonlinear system through iteration step by step. This on-line learning ability improves its performance by learning from its own mistakes through reinforcement signal from external

整理番号 2293 韓国

分類1 1 1 9

著者  
S. Jung, J. H. Lee, M. Yoon, H. Lee, G. Jang

タイトル  
Development of voltage regulation plan by composing subsystem with the SFES for DC On-Line Electric Vehicle

出典  
Physics Procedia 65

発行年 2015 PAGE. 295 – 298

概要  
The study of the application process of the relatively small size ‘Superconducting Flywheel Energy Storage (SFES)’ system is conducted to regulate voltage fluctuation of the DC On-Line Electric Vehicle (OLEV) system, which is designed by using DC power system network. It is recommended to construct the power conversion system nearby the substation because the charging system is under the low voltage. But as the system is usually built around urban area and it makes hard to construct the subsystems at every station, voltage drop can occur in power supply inverter that is some distance from the substation. As the alternative of this issue, DC distribution system is recently introduced and has

整理番号 2294 中国

分類1 1 1 4

著者  
Peng Hana, Yu Wu, Huajun Liu, Laifeng Li, Huihui Yang

タイトル  
Structural design and analysis of a 150 kJ HTS SMES cryogenic system

出典  
Physics Procedia 67

発行年 2015 PAGE. 360 – 366

概要  
A 150 kJ high temperature superconducting magnetic energy storage (HTS-SMES) system is under manufacturing in China. This paper focuses on the structural design and analysis of the SMES cryogenic system. The cryogenic system is designed and fabricated to maintain the working temperature. The system includes a vacuum vessel, its thermal radiation shield, its supporting devices, conduction plates, and current leads. Two G-M cryocoolers are used for the system cooling, the main one is connected to the HTS coils and the other is connected to the thermal shield and the lower ends of the current leads. In this study, the 3D models of the SMES cryogenic system were created with CATIA, a 3D model

整理番号	2295	中国	
分類1	1	1	9
著者	Jianwei Li, Min Zhang, Jiahui Zhu, Qingqing Yang, Zhenyu Zhang, Weijia Yuan		
タイトル	Analysis of Superconducting Magnetic Energy Storage Used in A Submarine HVAC Cable Based Offshore Wind System		
出典	Energy Procedia 75		
発行年	2015	PAGE. 691 - 696	
概要	Because of the booming development of offshore wind power around the world, a stable transmission system which is used for the connection between the offshore wind farms and the onshore grid is required. For the offshore wind farms not far from the coast, high voltage alternating current (HVAC) transmission system is the best choice. Aiming to study the transient problems caused by cable operation, a 60km submarine cable is modeled in this paper using ATP-EMTP. The larger capacitance effect of HVAC submarine cables will cause more severe transient problems. Also, the variable wind power generated by offshore wind farm will bring undesired impact on the onshore power grid. This paper		
整理番号	2296	中国	
分類1	1	1	9
著者	Xiaohan Shi, Shaorong Wang, Wei Yao *, Asad Waqar, Wenping Zuo and Yuejin Tang		
タイトル	Mechanism Analysis and Experimental Validation of Employing Superconducting Magnetic Energy Storage to Enhance Power System Stability		
出典	Energies, 8,		
発行年	2015	PAGE. 656-681	
概要	This paper investigates the mechanism analysis and the experimental validation of employing superconducting magnetic energy storage (SMES) to enhance power system stability. The models of the SMES device and the single-machine infinite-bus (SMIB) system with SMES are deduced. Based on the model of the SMIB system with SMES, the action mechanism of SMES on a generator is analyzed. The analysis takes the impact of SMES location and the system operating point into consideration, as well. Based on the mechanism analysis, the P-controller and Q-controller are designed utilizing the phase compensation method to improve the damping of the SMIB system. The influence of factors, such as		
整理番号	2297	インド	
分類1	1	1	9
著者	N.J. Vinoth Kumar, , M. Mohamed Thameem Ansari		
タイトル	A new design of dual-mode Type-II fuzzy logic load frequency controller for interconnected power systems with parallel AC-DC tie-lines and superconducting magnetic energy storage unit		
出典	Energy, vol. 89		
発行年	2015	PAGE. 118-137	
概要	LFC (Load frequency control) in power systems is very important to supply reliable electric power with good quality. In general, proportional PI (plus integral) controller is used for the LFC, which is incapable of obtaining good dynamic performance for a wide range of operating conditions. Type-I fuzzy logic controller (T-I FLC) is a sophisticated technique to use, but the designing of membership functions and control rules is an important function.. To achieve satisfactory membership function and control rules, a designer's experience is necessary. This conflict may be checked up by applying the principle of Type-II fuzzy logic controller (T-II FLC) to use expert knowledge and being adaptive in nature. The dual-mode		

整理番号 2298 英国

分類1 1 1 9

著者 Jianwei Li , Anthony M. Gee, Min Zhang, Weijia Yuan

タイトル Advanced configuration of superconducting magnetic energy storage

出典 Energy, vol. 86

発行年 2015 PAGE. 175-185

概要 In off-grid wind energy systems, batteries often undergo frequent charge/discharge cycles, which reduce battery service life. In addition, due to motor start and other high 'inrush current' loads batteries undergo high rates of discharge which also degrade battery life. In this paper, a superconducting magnetic energy storage and battery hybrid energy storage system is proposed, which is beneficial in reducing battery short term power cycling and high discharge currents. To demonstrate system performance, a representative off-grid wind power system model is described in detail which incorporates turbulent wind variations, load variations and energy storage systems. To estimate battery

整理番号 2299 イラン

分類1 1 1 5

著者 Mohammad Farhadi Kangarlua,, Mohammad Reza Alizadeh Pahlavani

タイトル Cascaded multilevel converter based superconducting magnetic energy storage system for frequency control

出典 Energy, vol. 70

発行年 2014 PAGE. 504-513

概要 The Super conducting magnetic energy storage (SMES), owing to high energy density and capacity, has been widely applied in different stages of power systems. One of these applications is the frequency control of the electric power systems. Frequency of a power system depends on the balance of produced and demanded energy in any instant of time. Subsequent to a sudden change in the system, which causes produced and demanded energy mismatch, frequency oscillates. According to standards, the permissible variation band of the frequency is very restricted. Larger swings of frequency may result in instability and undesirable trips. As a result, suitable frequency control mechanisms should be

整理番号 2300 インド

分類1 1 1 9

著者 Ramesh Kumar Selvaraju, Ganapathy Somaskandan

タイトル Impact of energy storage units on load frequency control of deregulated power systems

出典 Energy, vol. 97

発行年 2016 PAGE. 214-228

概要 Energy storage units are very vital for damping the oscillations due to the sudden changes in power system. The integration of small capacity energy storage unit to the power system in each area can effectively restrain the system oscillations. Hence in this paper, the energy storage devices, SMES (Superconducting Magnetic Energy Storage) units and RFB (Redox Flow Batteries) have been integrated into the interconnected deregulated LFC (Load Frequency Control) power system model and their effectiveness in improving the system performance has been realized and compared. The proposed controller design is applied to an interconnected two-area two-unit thermal deregulated power system

整理番号 2301 日本

分類1 1 1 1

著者 木村 祐介, 鎌田 太陽, 野村 新一 (明治大); 谷貝 剛 (上智大); 中村 武恒 (京大); 筒井 広明 (東工大); 力石 浩孝, 柳 長門, 今川 信作 (NIFS)

タイトル 高温超電導電磁力平衡ヘリカルコイルの開発 - モデルコイルの設計と巻線技術の検討 -

出典 2015年度春季低温工学・超電導学会予稿集

発行年 2015 PAGE. 7

概要 YBCO線材を使用した電磁力平衡ヘリカルコイルのモデルコイル設計について報告する。テープ形状のYBCO線材をヘリカル状に巻線を行う場合、テープ線に印加される余分な機械的応力を低減させるためにYBCO線のボビンを傾けながら巻線を行う必要がある。そこで本講演では、ヘリカルコイル軌道に沿ったYBCO線のボビンの傾き角を定式化し、テープ線をヘリカル状に巻くために必要となる自動巻線機の動作について検討し、高温超電導テープ線材のヘリカル巻線技術に関して議論する。

整理番号 2302 日本

分類1 1 1 1

著者 鎌田 太陽, 木村 祐介, 野村 新一 (明治大); 谷貝 剛 (上智大); 中村 武恒 (京大); 筒井 広明 (東工大); 力石 浩孝, 柳 長門, 今川 信作 (NIFS)

タイトル 高温超電導電磁力平衡ヘリカルコイル - ヘリカル巻線機試作機開発 -

出典 2015年度春季低温工学・超電導学会予稿集

発行年 2015 PAGE. 8

概要 高温超電導線を適用した電磁力平衡ヘリカルコイルの開発にあたり、巻線技術の検討と巻線機の開発を行っている。テープ形状の高温超電導線は機械的なひずみにより臨界電流値が大幅に低下するため、ヘリカル巻線を施す過程で印加されるひずみを低減する巻線方法の検討が重要になる。そこで本研究では高温超電導線の臨界電流値を低下させない巻線技術を確立するために、ヘリカル巻線機試作機の開発を進めている。本講演では、試作機開発の進捗状況について報告する。

整理番号 2303 日本

分類1 1 1 11

著者 葛 雅志, 安藤 憲之介, 水落 空, 高尾 智明, 谷貝 剛 (上智大); 新富 孝和, 榎田 康博 (KEK); 濱島 高太郎, 津田 理, 宮城 大輔 (東北大); 花田 一磨 (八戸工業大); 岩城 勝也 (岩谷産業); 駒込 敏弘 (前川)

タイトル MgB<sub>2</sub>線の臨界電流特性に影響する撚り線加工に伴う減面効果の測定

出典 2015年度秋季低温工学・超電導学会予稿集

発行年 2015 PAGE. 113

概要 我々は再生可能エネルギーを有効利用するためのシステムとして、先端超伝導電力変換システム(ASPCS: Advanced Superconducting Power Conditioning System)を提案している。ASPCSはSMES、燃料電池、電気分解装置から構成され、これらの組み合わせにより太陽光発電などの再生可能エネルギー源の変動出力を制御する。ASPCSに用いるSMESコイルの線材には、安価で将来性が見込まれているMgB<sub>2</sub>線材を検討しているが、MgB<sub>2</sub>線材は大容量化が必須で、そのためには撚り線加工が重要となる。そこで、MgB<sub>2</sub>線材の撚り線加工によるJ<sub>c</sub>への影響を調査した。

整理番号 2304 日本

分類1 1 1 1

著者 水落 空・葛 雅志・安藤憲之介・高尾智明・谷貝 剛(上智大学)・新富孝和・榎田康博(高エネルギー加速器研究機構)・津田 理・宮城大輔(東北大学)・岩城勝也(岩谷産業)

タイトル 27 MJ級マルチコイルに向けた6 MJ級シングルコイル設計

出典 平成28年電気学会全国大会講演概要集

発行年 2015 PAGE. 5-120

概要 太陽光発電等の再生可能エネルギーの出力は、天候に左右され変動する。そこで我々はSMES、燃料電池、電気分解装置で構成される先進超電導電力変換システム(ASPCS: Advanced Superconducting Power Conditioning System)を用いて再生可能エネルギーの変動を補償することを提案し、実用化を目指している。本研究では、SMESの規模を27 MJ / 600 kWとし、コイル構造は漏洩磁界を少なくするために4ポールマルチコイルを対象とした。解析には汎用シミュレーションソフトウェアであるCOMSOL Multiphysicsを用いて、貯蔵エネルギー6 MJとなるシングルコイルの設計を行い、経済性に影響する必要導体量を比較した。本研究では、必要導体量が最小となるのは内径1.44 m、外径2 m、高さ0.28 mにしたときであっ

整理番号 2305 日本

分類1 1 1 9

著者 宮嶋 諒,石田なつみ,佐藤裕貴,張 哲,宮城大輔,津田 理(東北大学), 濱島高太郎(前川製作所),榎田康博,新富孝和(高エネルギー加速器研究機構),岩城勝也(岩谷産業)

タイトル 再生可能エネルギー出力変動補償用電力・水素複合エネルギー貯蔵システムの入出力制御

出典 電気学会平成27年電力・エネルギー部門大会概要集

発行年 2016 PAGE. 118

概要 近年、再生可能エネルギーを利用した発電が注目されている。しかし、発電出力の変動が急峻で大きく、系統に大量導入する場合には予備力の確保や周波数変動への対策等が必要となる。そこで、Fig.1の様な、超電導磁気エネルギー貯蔵(SMES)と、燃料電池(FC)と電気分解装置(EL)で構成される水素システムを組み合わせた「先進超電導電力変換システム(ASPCS)」を提案し、ASPCSを構成する各機器の制御方法や変動補償特性について検討している(1)(2)。ASPCSでは、再生可能エネルギーの出力変動のうち、長周期変動成分を水素システムで、短周期変動成分をSMESシステムでそれぞれ補償する。しかし、FCは出力変動に伴いセルが劣化するため、長期連続運転には、FCの運転方法の改善が必要となる。そこで、本

整理番号 2306 日本

分類1 1 1 1

著者 水落 空,葛 雅志,安藤 憲之介,高尾 智明,谷貝 剛(上智大); 新富 孝和,榎田 康博(KEK); 津田 理,宮城 大輔(東北大); 岩城 勝也(岩谷産業); 駒込 敏弘(前川)

タイトル 電力・水素複合エネルギー貯蔵システムに用いるSMESコイル設計

出典 2016年度春季低温工学・超電導学会予稿集

発行年 2016 PAGE. 79

概要 我々は浄水場に用いる電力・水素複合エネルギー貯蔵システムを提案している。このシステムは主にSMES、FC、ELで構成され、通常時には再生可能エネルギーである太陽光発電の変動補償をすることで有効利用し、非常時には浄水場の非常用電源として3日分のエネルギーを確保する。1.0 MWまたは2.78 MWの規模の太陽光発電に併設して変動補償を行い、非常用電源としても稼働可能であるためには、SMESの規模としては10 MJ/600 kWまたは27 MJ/600 kW必要である。本研究の目的は、SMESコイルの主要課題として挙げられる低コスト化を目指し、必要導体量と設置面積の2点から最適なコイル形状を解析により求めた。

整理番号 2307 日本

分類1 1 1 1

著者 石山 敦士, 我妻 洸, 齊藤 隆 (早大); 野口 聡 (北大); 植田 浩史, 金 錫範 (岡山大); 渡辺 智則, 長屋 重夫 (中部電力)

タイトル (50T・500A/mm<sup>2</sup>・5GPa)-REBCO超電導コイルシステムの開発

出典 2016年度春季低温工学・超電導学会予稿集

発行年 2016 PAGE. 114

概要 これまで発表者らが開発を行ってきた高機械強度コイル(YOROI-coil)構造、無絶縁コイル巻線技術等を活用して、超高磁場・高電流密度・高機械強度の目標値を50T・500A/mm<sup>2</sup>・5GPa(フープ応力)に設定したREBCOコイル設計を試みた。これが実現すると、例えば、Liイオン電池の2倍の貯蔵密度(~600Wh/m<sup>3</sup>)のSMES用コイルシステムの開発が可能となる。以上について検討した結果を報告する。

整理番号

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概要

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