

超電導エネルギー貯蔵研究会

**SMES関連論文情報
(平成28年度版)**

平成29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
平成28年度	30	8	38
合計	1357	988	2345

出力一覧

□平成28年度入力分
No.2308 ～ 2345
全項目について出力

整理番号 2308 タイ

分類1 1 1 5

著者 Issarachai Ngamroo

タイトル Optimization of SMES-FCL for Augmenting FRT Performance and Smoothing Output Power of Grid-Connected DFIG Wind Turbine

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 3800405

概要 Fault-ride-through (FRT) performance and output power variation are crucial issues of the grid-connected wind turbine with the doubly fed induction generator (DFIG). To overcome these problems, the optimal parameters tuning of the superconducting magnetic energy storage and the fault-current limiter (SMES-FCL) with the common part of the superconducting coil (SC) is proposed. In addition to the alleviation of the DFIG output power, the SC behaves as the short-circuit current limiter to enhance the FRT capability. The tuning of the SC inductance and the controller parameters of converters is optimally conducted, so that the DFIG

整理番号 2309 中国

分類1 1 1 11

著者 Jian Xun Jin, Yue Jin Tang, Xian Yong Xiao, Bo Xue Du, Qiu Liang Wang, Jian Hua Wang, Shu Hong Wang, Yan Fang Bi, and Jian Guo Zhu

タイトル HTS Power Devices and Systems: Principles, Characteristics, Performance, and Efficiency

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 3800526

概要 As the critical barriers to advanced high-temperature superconducting (HTS) device technologies are overcome, practical HTS devices and systems have been enabled and become available for commercial application. In identifying the applicability of various HTS devices, their operation principles, characteristics, performance, and efficiency are fundamental. Consequently, the corresponding verification of a wide range of HTS devices, especially the HTS power devices and their system technologies, has been comprehensively carried out, and the analytical results are presented in detail towards their practical applications.

整理番号 2310 中国

分類1 1 1 1

著者 Xiao Yuan Chen, Jian Xun Jin, Juan Feng, Qiang Xu, Mian Gang Tang, and Hui Lin Zou

タイトル Performance Improvement of a Bi-2223 Solenoid Coil With Optimal Ferromagnetic Disks

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 4902507

概要 Solenoid-type superconducting magnetic energy storage (SMES) coils wound by Bi-2223 tapes have strong anisotropic magnetic field dependence due to the fundamental anisotropic property inherited from Bi-2223 materials. The maximum perpendicular field components appearing around the turns located at the two coil ends degrade the critical current and energy storage capacity of the whole coil, and even cause significant AC loss and possible hot-spots during practical SMES operations. To enhance the critical current and reduce the ac loss of the turns located at the two coil ends, this paper investigates a novel ferromagnetic raised-edge disk structure for adjusting the magnetic field orientation to be as close

整理番号 2311 タイ

分類1 1 1 1

著者 Worapong Kreeumporn and Issarachai Ngamroo,

タイトル Optimal Superconducting Coil Integrated Into PV Generators for Smoothing Power and Regulating Voltage in Distribution System With PHEVs

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 5402805

概要 Nowadays, the proliferation of photovoltaic (PV) generators and plug-in hybrid electric vehicles (PHEVs) into power distribution systems highly escalates. The variable PV power and the abrupt power charging of PHEVs result in system power and voltage fluctuations. This paper presents the new application of the superconducting coil (SC), which is connected between the dc link of PV generators to solve this problem. Using the dc-to-dc converter as an interfaced circuit, the SC can share the inverters with the PV generators. In addition, the PV generators with the common SC are able to provide the smooth

整理番号 2312 タイ

分類1 1 1 9

著者 Issarachai Ngamroo

タイトル Design of Optimal SMES Controller Considering SOC and Robustness for Microgrid Stabilization

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 5403005

概要 The microgrid with wind and photovoltaic (PV) power sources unavoidably encounters the power fluctuation problem. To solve this problem, the superconducting magnetic energy storage (SMES) can be used. Nevertheless, large power fluctuation from wind and PV sources, and severe system faults may cause the overcharge or deep-discharge state of SMES. These abnormal states highly degrade the dynamic performance of the SMES. To handle these situations, this paper concentrates on the new SMES power controller design considering state-of-charge (SOC), robustness, and optimal inductance of the

整理番号 2313 中国

分類1 1 1 11

著者 Xiao Yuan Chen and Jian Xun Jin

タイトル Energy Efficiency Analysis and Energy Management of a Superconducting LVDC Network

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 5403205

概要 A novel superconducting low-voltage direct-current (LVDC) power transmission and distribution network consisting of multiple superconducting dc cables and a superconducting magnetic energy storage (SMES) based hybrid energy storage system (HESS) is presented. The superconducting dc cables are favored for both high-efficiency power transmission under normal conditions and self-triggering fault-current-limiting operation under fault conditions. The SMES-based HESS is integrated, with the merits of fast response speed and high-power density from the SMES, and high-energy density and high-economic efficiency from conventional

整理番号 2314 中国

分類1 1 1 9

著者 Zi Xuan Zheng, Xian Yong Xiao, Chang Song Li, Zhen Chen, and Yin Zhang

タイトル Performance Evaluation of SMES System for Initial and Steady Voltage Sag Compensations

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 5701105

概要 This paper presents a voltage sag compensator (VSC) integrated with a superconducting magnetic energy storage (SMES) device. Performance evaluations of the SMES-based VSC for the initial and steady voltage sag compensations in sensitive load are carried out in details. Effects of time delay in discharge response and initial voltage sag angle on the initial voltage sag compensation are discussed to clarify the transient SMES property. In addition, three definitions of voltage sag compensation time duration are introduced to evaluate the steady SMES property of short-time and long-time voltage sag compensation operations.

整理番号 2315 アメリカ

分類1 1 1 9

著者 Yufei Tang, Chaoxu Mu, and Haibo He

タイトル SMES-Based Damping Controller Design Using Fuzzy-GrHDP Considering Transmission Delay

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 5701206

概要 In this paper, a novel active power oscillation damping controller for superconducting magnetic energy storage (SMES) is developed to increase the power system transient stability. The proposed damping controller is online adaptive learning by using the fuzzy-based goal representation heuristic dynamic programming (Fuzzy-GrHDP) algorithm. Moreover, to address the signal transmission delay in the communication channels, the delay information is incorporated into the training process to provide prior knowledge to the controller. A comparative simulation study between the traditional residue-based design and the proposed Fuzzy-GrHDP-based design is conducted on an IEEE 16-machine 68-bus

整理番号 2316 中国

分類1 1 1 10

著者 Zhen Chen, Xian Yong Xiao, Chang Song Li, Yin Zhang, and Zi Xuan Zheng

タイトル Study on Unit Commitment Problem Considering Large-Scale Superconducting Magnetic Energy Storage Systems

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 5701306

概要 Large-scale superconducting magnetic energy storage (SMES) systems with the advantages of high storage efficiency and no site limitation have significant impacts on the optimal operation and daily load leveling in modern power systems. In this paper, a combinatorial unit commitment (UC) optimization model incorporating large-scale SMES systems is investigated to minimize operation cost of the currently existing power system. A hybrid particle swarm optimization algorithm is employed to intelligently schedule the thermal units and the SMES system simultaneously. The results obtained from an IEEE ten-unit test system case show that the UC-SMES model is favored for UC optimization with

整理番号 2317 オーストラリア

分類1 1 1 1

著者 Gang Lei, Chengcheng Liu, Mohammad Jafari, Jianguo Zhu, and Youguang Guo

タイトル Multilevel Robust Design Optimization of a Superconducting Magnetic Energy Storage Based on a Benchmark Study

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 5701405

概要 Superconducting magnetic energy storage (SMES) systems with different superconducting materials are attracting great attentions and funding from the governments around the world because they are promising large-scale energy storage devices for future smart grid. Due to the high cost of SMES, its manufacturing quality and operation reliability have to be investigated in the design optimization stage. This paper presents a robust design optimization method to solve this issue based on a benchmark problem, TEAM problem 22. The proposed method is based on a technique called design for Six Sigma. Meanwhile, a three-level optimization framework is employed to reduce the computation cost of a

整理番号 2318 中国

分類1 1 1 5

著者 Yun Qi Xing, Jian Xun Jin, Ying Li Wang, Bo Xue Du, and Shan Chuan Wang

タイトル An Electric Vehicle Charging System Using an SMES Implanted Smart Grid

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 26, NO. 7

発行年 2016 PAGE. 5701504

概要 The battery lifetime of electric vehicles (EVs) has significant impacts on the development and popularization of EVs. A method with superconducting magnetic energy storage (SMES) to stabilize the EV charging system voltage to improve battery life and charge efficiency on a smart grid is presented. In order to verify the influence that the controlled SMES improves the system transient stability, situations under load fluctuation and fault, and the SMES capacity for system compensation have been investigated. The results obtained from the analysis indicate the effectiveness of compensating the instantaneous voltage dip in the grid and improving the power system quality.

整理番号 2319 中国

分類1 1 1 1

著者 Zhuang Wang, Yuejin Tang, Li Ren, Jingdong Li, Ying Xu, Yuxiang Liao, and Xuzhi Deng

タイトル AC Loss Analysis of a Hybrid HTS Magnet for SMES Based on H-Formulation

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 27, NO. 4

発行年 2017 PAGE. 4701005

概要 AC loss is an unavoidable problem for a conduction-cooled HTS superconducting magnetic energy storage (SMES) magnet during dynamic operation, which may cause a temperature raise and affect the reliable operation of the magnet. In this paper, the anisotropic homogenization method is employed to realize the modeling of a 150 kJ hybrid SMES magnet based on H-formulation. The SMES magnet has a maximum of approximately 7000 turns. First, the homogenization method is validated that it can reasonably predict the ac losses of both YBCCO coils and BSCCO coils, but it has lower accuracy to estimate the ac losses of BSCCO coils than YBCO coils. Then, ac loss characteristics of the

整理番号	2320	中国
分類1	1	1 11
著者	Aobo Zhou, Jing Shi, Qi Dai, Zhongping Zhang, Zhong Xia, Xiao Zhou, Chi Zhang, and Yuejin Tang	
タイトル	The Supplementary Design Method of HTS SMES System Considering Voltage Distribution Characteristic	
出典	IEEE TRANS. APPL. SUPERCOND., VOL. 27, NO. 4	
発行年	2017	PAGE. 4900305
概要	In the latest design studies of superconducting magnetic energy storage (SMES) systems, the emphasis was put on the electromagnetic design of SMES magnets without giving due attention to the electrical design with a view to eliminating the overvoltage problem. The power conditioning system (PCS) interfaces with the superconducting magnet and the ac system through an electrical connection. With a pulse-width modulation converter usually adopted in the PCS, the high-frequency overvoltage problem is even more serious. Therefore, electrical design based on voltage distribution analysis and protection measures should be taken into account during the SMES design. This paper first gives transient models	
整理番号	2321	日本
分類1	1	1 1
著者	Shinichi Nomura, Member, IEEE, and Hiroaki Tsutsui	
タイトル	Structural Limitations of Energy Storage Systems Based on the Virial Theorem	
出典	IEEE TRANS. APPL. SUPERCOND., VOL. 27, NO. 4	
発行年	2017	PAGE. 5700106
概要	Based on the virial theorem, the structural limitations are compared among superconducting magnetic energy storage (SMES), flywheels, and capacitors. The conventional SMES coils such as toroidal field coils (TFCs) and solenoids and the capacitor generate the compressive stresses. Due to this, the ratio of the stored energy to the required mass of the structure (U/M ratio) is lower than that of the flywheel. The flywheel almost achieves the uniform tensile stress distribution to support the centrifugal force and enables the enhancement of the U/M ratio. Based on the development status, the superconducting coils and the conventional flywheels composed of steel metals achieve almost 12 kJ/kg of the U/M ratio.	
整理番号	2322	中国
分類1	1	1 1
著者	Yi Li, Timing Qu, Mingshuo Wu, Nannan Hu, Feng Feng, Chen Gu, and Zhenghe Han	
タイトル	Stress Reduction and Storage Capacity Enhancement of the HTS-SMES Using Reinforcing Overbanding Structure	
出典	IEEE TRANS. APPL. SUPERCOND., VOL. 27, NO. 4	
発行年	2017	PAGE. 5700205
概要	High-energy high-temperature superconducting magnetic energy storage (HTS-SMES) is expected to play an important role in stabilizing the future smart micro grid. Large-scale and high-field magnet is required for high-energy SMES. However, the significant hoop stress induced by the Lorentz force has become one of the most serious threats. In this paper, we proposed a solution to reduce the hoop stress by overbanding the solenoidal magnet with high Young's modulus and yielding strength reinforcing structure. A unique graphical method was developed to optimize the geometry of the magnet and reinforcing overbanding structure to achieve high energy capacity. According to our analysis, thin-	

整理番号 2323 中国

分類1 1 1 5

著者 Zhong Xia, Yuejin Tang, Jing Shi, Li Ren, Aobo Zhou, Yi Zhang, Siyuan Liang, and Chi Zhang

タイトル Verification of HTS SMES Lumped Parameter Network Model

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 27, NO. 4

発行年 2017 PAGE. 5700305

概要 HTS Superconducting superconducting magnetic energy storage (SMES) can be utilized to ensure stable operation and high high-quality power supply in power systems. The lumped parameter network model of the magnet, which is taken example by transformer transient model, composed of self-inductances, mutual couplings, and series and shunt capacitances, is typically used to analyze the voltage distribution on the HTS magnet. The model is helpful in regards to the insulation design of SMES magnets, so its accuracy is a crucial consideration. This paper introduces an HTS SMES lumped parameter network model and corresponding parameter calculation technique. Tests were run on under various conditions

整理番号 2324 イタリア

分類1 1 1 1

著者 Antonio Morandi, Antonino Fiorillo, Salvatore Pullano, and Pier Luigi Ribani

タイトル Development of a Small Cryogen-Free MgB₂ Test Coil for SMES Application

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 27, NO. 4

発行年 2017 PAGE. 5700404

概要 MgB₂ material operating at moderate field can conveniently be considered for short-term cost-effective implementation of superconducting magnetic energy storage (SMES). Due to the intrinsic performance of this material, moderate field operation and cryogen free cooling in the range 10–20 K need to be considered. For investigating the feasibility of MgB₂ based SMES technology a 10 kW–2 s system is under development. A small MgB₂ coil was developed and tested as the first step of this study. The cooling was obtained by means of a cryogen-free test facility based on a two stages Gifford–McMahon regenerative heat exchanger. A power conditioning system (PCS) was also developed in order to

整理番号 2325 中国

分類1 1 1 1

著者 Hongwei Liu, Guosheng Song, Wengang Feng, Ming Qiu, Jiahui Zhu, and Shuangquan Rao

タイトル Strain Characteristic of a Toroidal HTS-SMES Fabricated by YBCO Stacked-Tape Cables

出典 IEEE TRANS. APPL. SUPERCOND., VOL. 27, NO. 4

発行年 2017 PAGE. 5700505

概要 In need of high current carrying capacity, tapes are usually assembled in a cable. There are several cable options and one of them is the YBCO stacked-tape cable. In this paper, four YBCO tapes were stacked and pancake coils were constructed, which are the components of a toroidal superconducting magnetic energy storage system. The stacked-tape cable could improve the operating current of the toroidal magnet, and, therefore, increase the stored energy. However, the stress experienced by the conductor will also be very high. In this paper, numerical simulation analyses of stress and strain combining electromagnetic fields and mechanical behaviors were performed to investigate the effect of the

整理番号 2326 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 2016 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 2327 日本

分類1 1 1 1

著者 N Sugimoto, N Iguchi, Y Kusano, T Fukano, T Hioki, A Ichiki, T Bessho and T Motohiro

タイトル Compact SMES with a superconducting film in a spiral groove on a Si wafer formed by MEMS technology with possible high-energy storage volume density comparable to that of rechargeable batteries

出典 Supercond. Sci. Technol. 30

発行年 2016 PAGE. 015014

概要 The concept of a novel approach to make a compact SMES unit composed of a stack of Si wafers using a well-established MEMS process was proposed. The concept was backed up by pilot estimations for energy storage capacity and mechanical strength to endure electromagnetic stress. The estimated volume density of the storable energy is comparable to that of rechargeable batteries and the mechanical strength of Si wafer endures the electromagnetic stress imposed on it. These estimations support the feasibility of this novel concept, although there needs to be more detailed design of the system for its practical realization. Furthermore, there are a lot of challenges to overcome. The first

整理番号 2328 イラン

分類1 1 1 1

著者 Arsalan Hekmati and Rasoul Hekmati

タイトル Double pancake superconducting coil design for maximum magnetic energy storage in small scale SMES systems

出典 Cryogenics 80

発行年 2016 PAGE. 74 - 81

概要 Electrical power quality and stability is an important issue nowadays and technology of Superconducting Magnetic Energy Storage systems, SMES, has brought real power storage capability to power systems. Therefore, optimum SMES design to achieve maximum energy with the least length of tape has been quite a matter of concern. This paper provides an approach to design optimization of solenoid and toroid types of SMES, ensuring maximum possible energy storage. The optimization process, based on Genetic Algorithm, calculates the operating current of superconducting tapes through intersection of a load line with the surface indicating the critical current variation versus the parallel and perpendicular

整理番号 2329 日本

分類1 1 1 4

著者 Naoki Hirano, Tomonori Watanab and Shigeo Nagaya

タイトル Development of cooling technologies for SMES

出典 Cryogenics 80

発行年 2016 PAGE. 210 – 214

概要 A Superconducting Magnetic Energy Storage (SMES) system has good characteristics as energy storage equipment in electric power systems such as high efficiency, quick response and no deterioration in repetition operation. Since 1991, the Agency for National Resources and Energy Japan has carried out a national project to develop an SMES for power control in power systems. Moreover, SMES has been developed to bridge for instantaneous voltage dips since 2003. A field test of 5 MVA SMES for bridging instantaneous voltage dips was carried out on an advanced large liquid crystal TV plant in Kameyama from July 2003. Before that, a 10 MVA SMES system was working there. After the field test, the

整理番号 2330 中国

分類1 1 1 5

著者 Jun Yan, Liling Zhang, Xinpu Wang, Lei Chen and Yanxia Chen

タイトル The impact of SFCL and SMES integration on the distance relay

出典 Physica C 530

発行年 2016 PAGE. 151 – 159

概要 The superconducting fault current limiter (SFCL) is an ideal short-circuit fault current limiting device that can limit the fault current without any delay and control the voltage drop of the non-fault line. The superconducting magnetic energy storage (SMES) device can exchange the active and reactive power independently, so it is applied broadly to improve power system stability. With SFCL, the low voltage ride-through capability of SMES can be enhanced as well as its MW and MJ capacities. The distance relay is a key electrical apparatus that will trip circuit breakers to protect electrical devices from short circuit faults. Due to the application of SFCL and SMES integration, the voltage and current in power

整理番号 2331 インド

分類1 1 1 9

著者 Shailendra Singha, Deepak Tyagi, Ashwani Kumar and Saurabh Chanana

タイトル Load Shedding in Deregulation Environment and Impact of Photovoltaic System with SMES

出典 Energy Procedia 90

発行年 2016 PAGE. 412 – 422

概要 With the continuous increase in the load, the frequency of the system goes on decreasing and it reaches to its minimum allowable value after the further increase in load will result in more frequent drop resulting in the need of load shedding. To avoid load shedding and control of the frequency of the systems some approach have discussed here. The paper includes modeling of SMES with solar PV array for frequency control of three areas interconnected thermal system in deregulated environment. A comparative analysis of different load frequency control scheme such as:
i) Using conventional integral controller

整理番号 2332 エジプト

分類1 1 1 9

著者 Mohamed M. Aly, Emad A.Mohamed, Hossam S. Salama, Sayed M. Said, Mamdouh Abdel-Akher and Yaser Qudaih

タイトル A developed Voltage Control Strategy for Unbalanced Distribution System during Wind Speed Gusts Using SMES

出典 Energy Procedia 100

発行年 2016 PAGE. 271 - 279

概要 The fast response, high efficiency and long lifetime of superconducting magnetic energy storage (SMES) compared to other energy storage systems make it a preferable selection for energy storage solution for wind power generation. SMES has attracted many researchers to study its potential applications in power systems. This paper discusses a scheme of fuzzy logic controlled SMES to minimize the voltage fluctuations of three-phase unbalanced radial distribution systems connected to wind energy conversion system (WECS) with large scale penetration level of 30% during wind speed gusts. In this paper, wind turbine used is of squirrel cage induction generator (SCIG) with shunt connected capacitor bank for

整理番号 2333 英国

分類1 1 1 9

著者 Jianwei Li, Qingqing Yang, Pengfei Yao, Qixing Sun, Zhenyu Zhang, Min Zhang and Weijia Yuan

タイトル A novel use of the hybrid energy storage system for primary frequency control in a microgrid

出典 Energy Procedia 103

発行年 2016 PAGE. 82 - 87

概要 High penetration of renewable energy causes fluctuations of power flow and results in system frequency fluctuation, which significantly affects the power system operation. The situation in microgrid (MG) is worse because of the low inertia and small time constant of the system. This paper present a novel use of the superconducting magnetic energy storage (SMES) and battery hybrid energy storage system with the function of frequency control in the MG. A hybrid power management strategy for the SMES and the battery is used to achieve, firstly, a faster primary frequency control and secondly, an improvement of battery service time.

整理番号 2334 インド

分類1 1 1 8

著者 U Bhunia, J Pradhan, A De, A Roy, V K Khare, M K Dey, S K Thakur, S Sah1 and H Kanithi

タイトル Transient stability of NbTi Rutherford cables for energy storage magnet applications

出典 IOP Conf. Series: Materials Science and Engineering 171

発行年 2017 PAGE. 012148

概要 Stability and quench behavior against transient perturbation expected during operation of a fast cycling energy storage magnet is an important issue for its design and safe operation. Understanding of thermal stability in terms of minimum quench energy (MQE) of a superconducting cable under specific operating scenario is of primary importance for its magnet application. Process of current redistribution from quench strand to adjacent strands depends on inductive coupling and has influence on quench development in the cable. The lectrodynamic and thermal behavior of a ten-strand Rutherford-type cable for SMES program in the centre is studied numerically in the framework of discrete network

整理番号	2335	中国	
分類1	1	1	9
著者	Lei Chen, Hongkun Chen, Jun Yang, Yanjuan Yu, Kaiwei Zhen, Yang Liu and Li Ren		
タイトル	Coordinated Control of Superconducting Fault Current Limiter and Superconducting Magnetic Energy Storage for Transient Performance Enhancement of Grid-Connected Photovoltaic Generation System		
出典	Energies 10		
発行年	2017	PAGE. 56	
概要	In regard to the rapid development of renewable energy sources, more and more photovoltaic (PV) generation systems have been connected to main power networks, and it is critical to enhance their transient performance under short-circuit faults conditions. This paper proposes and studies the coordinated control of a flux-coupling-type superconducting fault current limiter (SFCL) and a superconducting magnetic energy storage (SMES), to improve the fault ride through (FRT) capability and smooth the power fluctuation of a grid-connected PV generation system. Theoretical analyses of the device structure, operating principle and control strategy are conducted, and a detailed simulation model		
整理番号	2336	中国	
分類1	1	1	11
著者	Xin Wang, Jun Yang, Lei Chen and Jifeng He		
タイトル	Application of Liquid Hydrogen with SMES for Efficient Use of Renewable Energy in the Energy Internet		
出典	Energies 10		
発行年	2017	PAGE. 185	
概要	Considering that generally frequency instability problems occur due to abrupt variations in load demand growth and power variations generated by different renewable energy sources (RESs), the application of superconducting magnetic energy storage (SMES) may become crucial due to its rapid response features. In this paper, liquid hydrogen with SMES (LIQHYSMES) is proposed to play a role in the future energy internet in terms of its combination of the SMES and the liquid hydrogen storage unit, which can help to overcome the capacity limit and high investment cost disadvantages of SMES. The generalized predictive control (GPC) algorithm is presented to be appreciatively used to eliminate the frequency		
整理番号	2337	英国	
分類1	1	1	9
著者	Jianwei Li, Qingqing Yang, Francis. Robinson, Fei Liang, Min Zhang and Weijia Yuan		
タイトル	Design and test of a new droop control algorithm for a SMES/battery hybrid energy storage system		
出典	Energy 118		
発行年	2017	PAGE. 1110 - 1122	
概要	High capacity energy storage units are desirable to maintain power system stability in the presence of power disturbances produced by renewable energy sources and fluctuating load profiles. Battery energy storage systems may be used to smooth power flow, however, the frequent, deep charge and discharge cycling required dramatically reduces battery service life. A hybrid energy storage system (HESS) using battery energy storage with superconducting magnetic energy storage (SMES) is proposed to mitigate battery cycling while smoothing power flow. A HESS power sharing control method based on the novel use of droop control is proposed. This is able to control charge/discharge prioritization and hence		

整理番号 2338 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, 新富 孝和, 槇田 康博, 津田 理, 宮城 大輔, 平野 直樹, 岩城 勝也, 駒込 敏弘

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 第93回 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 239 日本

分類1 1 1 1

著者 谷貝 剛, 水野伸哉, 大久保徹, 安藤憲之介, 水落 空, 高尾智明, 平野直樹, 槇田康博, 新富孝和, 駒込敏弘, 塚田謙一, 恩地太紀, 荒井有気, 富田 優, 濱島高太郎

タイトル MgB2線材を用いたR&W方式大容量導体とSMESコイルの設計

出典 電気学会応用超伝導研究会

発行年 2017 PAGE. ASC-17-001

概要 MgB2 wire becomes more attractive for large scale applications like superconducting magnetic energy storage (SMES) due to developing superconducting characteristic and reducing it cost. For large scale applications, the MgB2 must be used by forming conductors assembled and twisted conductor to aim at getting large current capacity. Through the coil winding process with pancake winding technique, we are planning to make around 33 kJ stored energy magnet system for an energy storage device. In terms of coil and

整理番号 2340 日本

分類1 1 1 8

著者 安藤憲之介, 水落 空, 上林昌弘, 神保茉那, 高尾智明, 谷貝 剛, 新富孝和, 槇田康博, 濱島高太郎, 駒込敏弘, 塚田謙一, 平野直樹, 富田 優, 恩地太紀, 木須隆暢

タイトル 大電流化に向けたMgB2撚線の開発

出典 電気学会応用超伝導研究会

発行年 2017 PAGE. ASC-17-014

概要 我々は、安価で将来性が見込まれるMgB2線材を撚線化することによって、コイル用大容量導体の開発を目指している。基礎的な知見を得るため、異なる撚りピッチの3本撚線を作成しIC測定を行うことで、撚線加工中にフィラメントに加わる歪と電流特性の関係を調査した。また、コイル試作用に8本のMgB2線で構成されるラザフォードケーブルを作成し、電流特性を調査した。

整理番号 2341 日本

分類1 1 1 1

著者 水野伸哉・谷貝 剛・大久保 徹・高尾智明・平野直樹・榎田康博・新富孝和・恩地太紀・駒込敏弘・濱島高太郎

タイトル MgB2線材を用いたR&W方式大容量導体とSMESコイル設計

出典 平成29年電気学会全国大会 講演要旨

発行年 2017 PAGE. 5-133

概要 発電部門の低炭素化を目的に、我々は太陽光発電出力のうち長周期成分を燃料電池と水電解装置、短周期成分に超電導磁気エネルギー貯蔵装置(SMES)を用いて補償することで、一定の電圧に制御するシステムを構築する。近年、大量の液体水素(LH2)への需要が高まりを受け、SMES用線材として、資源が豊富、かつ低コスト化が見込まれ、LH2温度で超電導特性を示すMgB2線の採用し大容量導体、コイル化技術開発に着手した。電力貯蔵用ダブルパンケーキコイル製作手法として、主に熱処理後にコイル巻き線を行うリアクト&ワインド(R&W)方式に関して、複合曲げ歪を評価し、その許容範囲で大容量導体およびSMESコイルの設計について詳細な検討を行ったので報告する。

整理番号 2342 日本

分類1 1 1 8

著者 神保茉那・安藤憲之介・水落 空・上林昌弘・高尾智明・谷貝 剛・新富孝和・榎田康博・濱島高太郎・駒込敏弘

タイトル 大電流化に向けたMgB2燃線の臨界電流特性

出典 平成29年電気学会全国大会 講演要旨

発行年 2017 PAGE. 5-139

概要 我々はMgB2を用いた超電導電力貯蔵装置(SMES: Superconducting Magnetic Energy Storage)の大容量化を検討している。MW級の入出力を行うSMESコイルに対応させるためには、単線で数百A級であるMgB2線材は燃り線加工による多芯化が必要である。基礎的な知見を得るため本研究では3本燃線を作成し、臨界電流特性と素線ごとの接続抵抗を調査した。3本燃線の各素線をそれぞれwire ①、②、③としたとき、一番接続抵抗が小さい通電電流が328 Aのときwire ②が最初に電圧が立ち上がった。次に接続抵抗の低いwire ③は360 Aのときに立ち上がり、一番接続抵抗が大きいwire ①は398 Aまでの通電では電圧は立ち上がらなかった。以上より、素線ごとの接続抵抗の違いが偏流を引き起こすと考えられる。

整理番号 2343 日本

分類1 1 1 8

著者 林昌弘・安藤憲之介・水落 空・神保茉那・高尾智明・谷貝 剛・新富孝和・榎田康博・濱島高太郎・木須隆暢

タイトル 燃りピッチに依存する燃線の臨界電流特性

出典 平成29年電気学会全国大会 講演要旨

発行年 2017 PAGE.

概要 MgB2線の応用例の一つとして、私たちの提案する先進超伝導電力変換システム(ASPCS)が1 MW出力するためには、SMESの貯蔵エネルギーは50 MJを想定し、その定格電流は2.2 kAである。本研究では、異なる燃りピッチを持つ3本燃線を作成し、ほぐした素線のIC測定を行うことでフィラメントに加わる歪と臨界電流特性の関係性を調査した。燃りピッチが短いほど劣化は大きく、電流特性はフィラメントに加わる歪に依存していると考えられる。また、LP = 13.5 mm の燃り解し素線の断面を観察した結果、一部のフィラメントでNb/バリアの破損が確認された。これによりMgB2の生成率が減少し、臨界電流特性が劣化したと考えられる。

整理番号 2344 日本

分類1 1 1 1

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タイトル MgB2 ケーブルを用いたパンケーキコイルの開発

出典 第94回 2017年度春季低温工学・超電導学会予稿集

発行年 2017 PAGE. 69

概要 MgB2 は、金属系超電導体最高の約 40 K の T_c をもち、各種コイルへの応用が検討されている。我々のグループでは、伝導冷却による数 10 kJ 級の超電導電力貯蔵システム (SMES) の開発を目指し [1, 2]、MgB2 線材を用いたパンケーキコイルの設計、製作を行っている。本研究では、Hyper Tech 社の熱処理前の MgB2 超電導素線を用い、撚線加工により導体作製、Wind & React (W&R) 方式でのパンケーキコイルの製作、ならびに特性評価を行ったので報告する。

整理番号 2345 日本

分類1 1 1 1

著者 大久保徹, 水野伸哉, 谷貝剛, 水落空, 上林昌弘, 神保茉那, 高尾智明, 平野直樹, 槇田康博, 新富孝和, 駒込敏弘, 塚田謙一, 恩地太紀, 荒井有気, 富田優, 濱島高太郎

タイトル MgB2 線材を用いた大電流量導体設計と SMES 用ダブルパンケーキコイルの安定性解析

出典 第94回 2017年度春季低温工学・超電導学会予稿集

発行年 2017 PAGE. 167

概要 MgB2 線材の特性向上は 2T 程度の磁場で臨界電流密度が $1000\text{A}/\text{mm}^2$ を超えるものが市販されており、一方で次世代の電力システムでは、低炭素化を目指した水素の積極利用と再生可能エネルギーによる発電の導入量増加が期待されている。我々のグループでは、MgB2 線材を用いた数 10kJ 規模の SMES コイルを液体水素間接冷却し、不安定な再生可能エネルギーの発電出力を安定化するシステムの開発を目指している。MgB2 コイルの製作では、熱処理前後の許容歪み範囲内での大電流量導体およびコイル設計が必要である。本計画では、熱処理後に撚り線・巻き線または撚り線後に熱処理して巻き線するリアクト・アンド・ワインド (R&W) および撚り線と巻き線後に熱処理するワインド・アンド・リアクト (W&R) 法によるコイル製作を予定しており、歪みによる劣化を防ぎ、かつ熱的に安定なコイル設計・運転条件に関する包括的な研究が重要である。本報告では、このうち W&R コイル製作のための許容歪み内導体設計およびコイルの熱的安定性に関して報告を行う。

整理番号

分類1

著者

タイトル

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