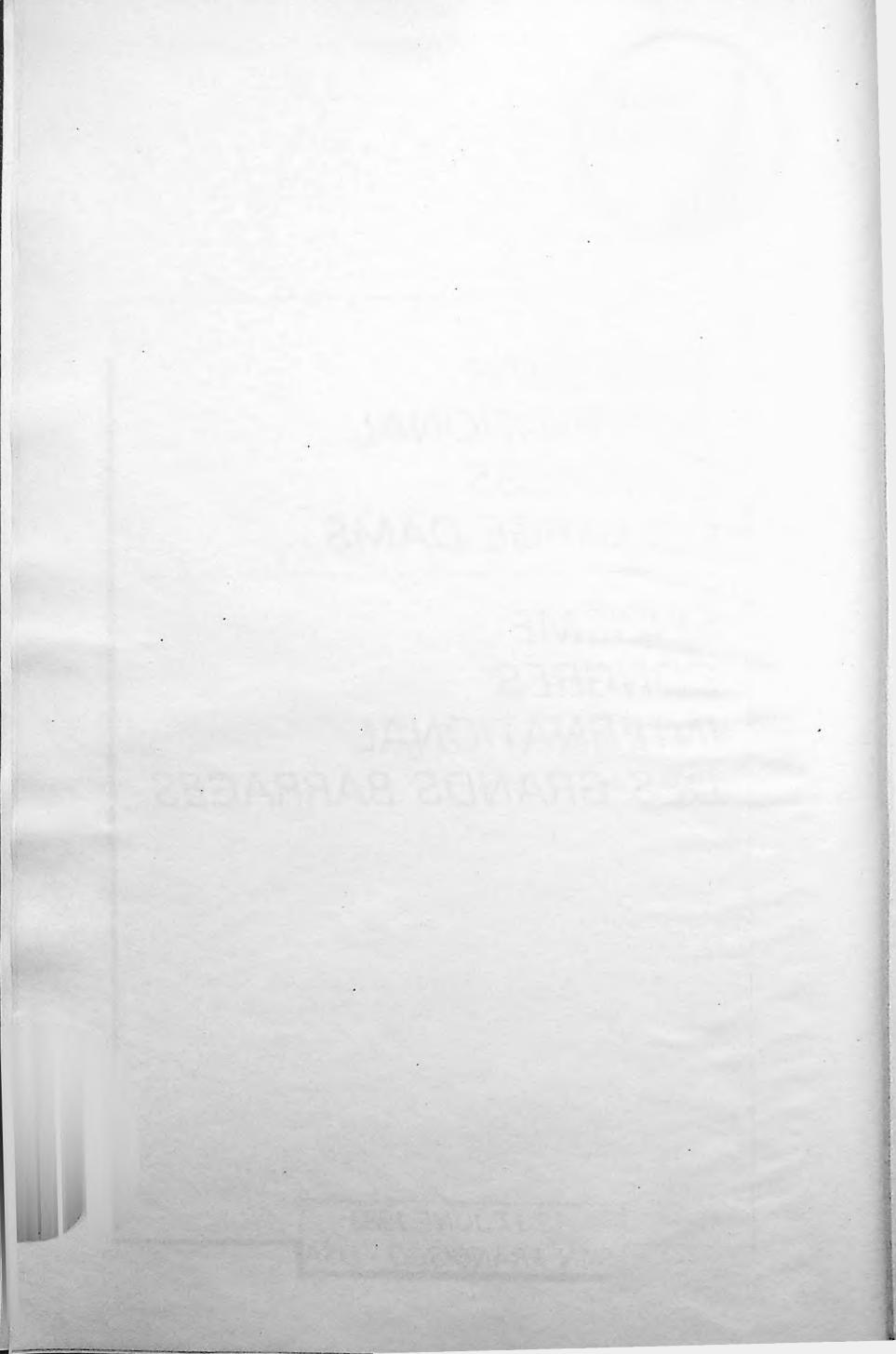




SIXTEENTH
INTERNATIONAL
CONGRESS
ON LARGE DAMS

SEIZIÈME
CONGRÈS
INTERNATIONAL
DES GRANDS BARRAGES

13-17 JUNE 1988
SAN FRANCISCO - USA



VOLUME

4

QUESTION 63

TRANSACTIONS

COMPTE RENDUS

*Published by the
International Commission
on Large Dams*

*Publiés par
la Commission Internationale
des Grands Barrages*

151, bd Haussmann, 75008 Paris, France
Tél. : 47 64 68 24 - 47 64 67 33 - 47 64 54 38
Telex : 641320 F

NOTE

Units of Measurement

As for the previous Congresses and though some authors do not fully agree, we attempt to follow the recommendations of the International System of Units (SI).

For example, hm^3 and km^3 were preferred to 10^6 and 10^9 m^3 , or million and billion cu.m. See Bulletin 34 "ICOLD Guide for the International System of Units (SI)", page 13.

The decimal sign may be the full stop (Anglo-Saxon usage) or the comma (European usage); but as a safeguard against confusion, full stop (period) and comma are used as decimal sign only.

Where the number of digits before or after the decimal sign exceeds three, the digit should be divided into groups of three by half space.

We meet not enough co-operation from some authors writing in English who go on keeping the comma to separate the groups of three digits instead of using half space. It was not possible to make the appropriate corrections in all the tables provided by the authors and even in the text. Sorry for the inconvenience.

AVERTISSEMENT

Unités de Mesure

Comme pour les Congrès précédents et bien que certains auteurs manifestent des réticences à ce sujet, on s'est efforcé de suivre les recommandations du Système International d'Unités (SI).

Par exemple, on a utilisé plus volontiers hm^3 et km^3 au lieu de 10^6 m^3 et 10^9 m^3 ou million et milliard de mètres cubes. Voir Bulletin 34 « Guide CIGB du Système International d'Unités (SI) », page 13.

De même, on a retenu le point (usage anglo-saxon) et la virgule (usage européen) comme signe décimal, mais pour éviter toute confusion, la virgule et le point ne sont utilisés que comme signe décimal.

Aussi, quand le nombre de chiffres avant ou après la virgule est supérieur à 3, les chiffres sont groupés par 3, chaque groupe étant séparé par un court espace.

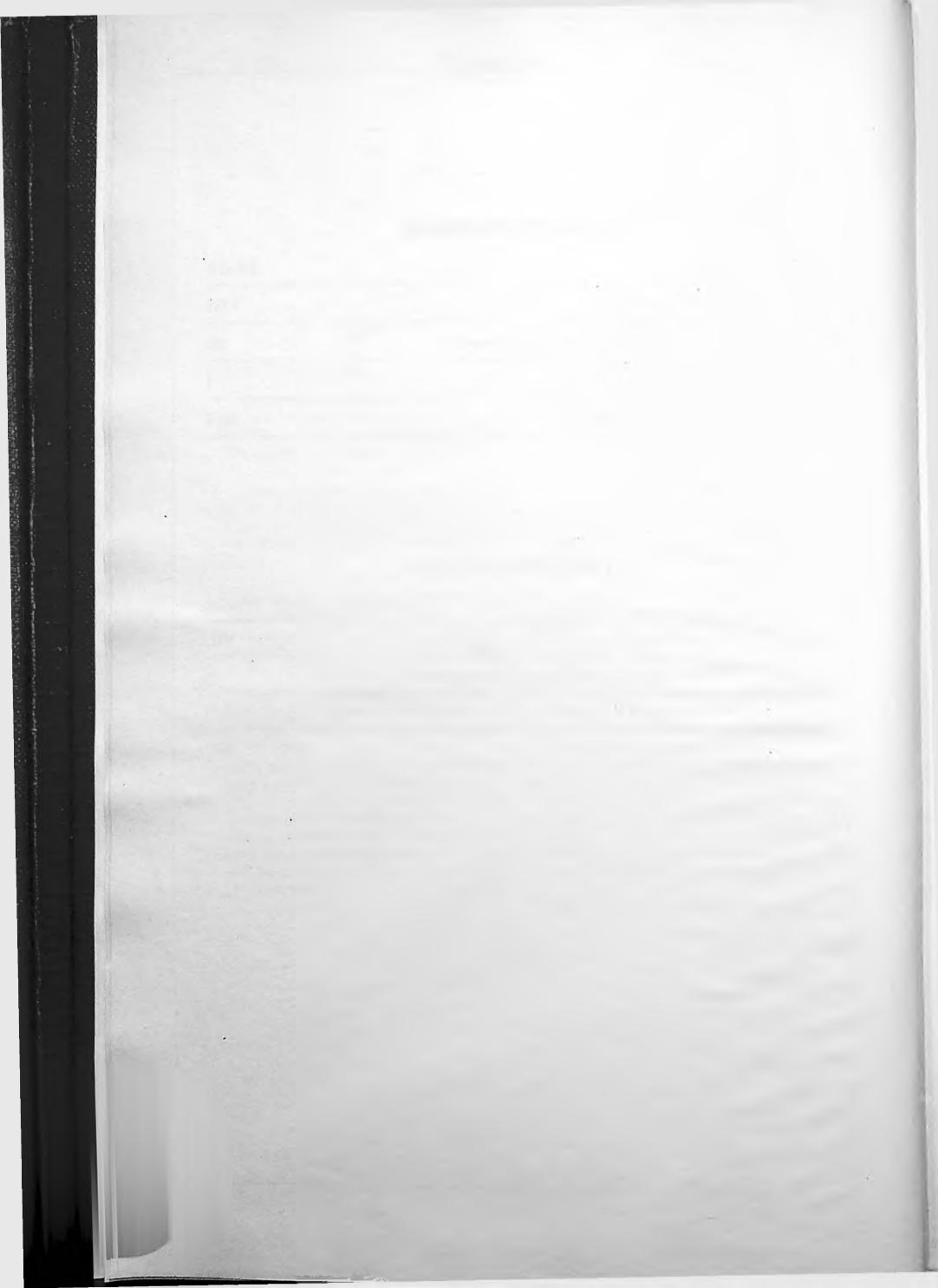
A ce sujet nous rencontrons encore des difficultés de la part de quelques auteurs de langue anglaise qui continuent à utiliser la virgule au lieu d'un court espace pour séparer les groupes de trois chiffres. Nous n'avons pas pu apporter les corrections nécessaires dans tous les tableaux fournis par les auteurs et même dans le texte. On voudra bien nous en excuser.

TABLE OF CONTENTS

	PAGE
Wording of Question 63	VIII
Table of Contents of Papers on Question 63	IX
Papers on Question 63	1
General Report Question 63	1621

TABLE DES MATIÈRES

	PAGE
Libelle de la Question 63	VIII
Table des Matières des Rapports sur la Question 63	IX
Rapports sur la Question 63	1
Rapport Général Question 63	1621



PAPERS ON Q 63

RAPPORTS SUR LA Q 63

QUESTION

63

Design flood and operational flood control

Subject

- a) Determination of design flood.
- b) Determination of construction flood.
- c) Criteria for choice of spillways and outlets.
- d) Design flood and reservoir, spillway and outlet operation, during repair works.
- e) Operation security - Flood warning system.
- f) Unpredicted high flood : case histories.

**Crue de projet et maîtrise des crues
après mise en service du barrage**

Objet

- a) Détermination de la crue de projet.
- b) Détermination de la crue de chantier.
- c) Critères de choix des ouvrages d'évacuation définitifs.
- d) Détermination de la crue, exploitation de la retenue et des ouvrages d'évacuation, dans le cas de travaux de réparation d'un barrage.
- e) Sécurité d'exploitation - Système d'annonce des crues.
- f) Crue importante imprévue : exemples.

	Page
R. 1. J. RIOS, V. BARBALHO (<i>Brésil</i>) Les consignes de l'évacuateur de crue de l'usine de Tucurui	1
R. 2. R. VIERA DE CARVALHO, G. MAGELA PEREIRA, H. MELLO DE MORAES, A. LIMA DE ARAUJO (<i>Brazil</i>) Historic flood during the 2nd phase of Tocantins river diversion for the construction of Tucurui Power Plant	11
R. 3. L. F. PIERRE, V. HERNANDEZ (<i>Brazil</i>) Design flood for the Garabi Hydroelectric Plant	19
R. 4. E. CARVALHO, C. ALMEIDA DE SOUZA, J. E. MAIA CASTRO, F. A. MESQUITA FERREIRA (<i>Brazil</i>) Sao Félix Hydroelectric Project - Design flood	33
R. 5. A. IHA, J. AYRES DE CAMPOS, E. A. LARROSA BEQUIO (<i>Brazil</i>) Hydroelectric Complex of Altamira - Spillway type selection at Jurua Dam	45
R. 6. E. CARVALHO, E. FUKS (<i>Brazil</i>) Sao Félix Hydroelectric Project - Associated risks to construction stages	59
R. 7. A. RIBEIRO (<i>Portugal</i>) Portuguese Douro (national and international) - Criteria for the construction diversion - Floods and cofferdams	69
R. 8. P. MEILLAND, O. CAYLA (<i>France</i>) Les méthodes de calcul de la crue de projet et la garantie de fonctionnement des évacuateurs	79
R. 9. E. KLEIVAN, I. TORBLAA (<i>Norway</i>) Opinions on ungated vs gated spillway for embankment dams	97
R. 10. J. R. VILLALBA, L. A. SEIFART, A. SZPILMAN, J. A. ROSSO, C. PIASENTIN, A. S. FIORINI (<i>Brazil</i>) Safety criteria adopted for construction of the Itaipu cofferdams	107
R. 11. Z. J. HELD (<i>Poland</i>) An unexpected flood at the Włocławek Reservoir, in 1982	129
R. 12. S. JANSSON, S. SOERACHMAD (<i>Sweden</i>) Criteria for choice of low-level outlet at embankment dams	141
R. 13. A. LENCASTRE, D. COELHO (<i>Portugal</i>) Flood flows under uncertainty - Pequenos Libombos Dam in Mozambique	157
R. 14. K. TERAZONO, M. KURODA, T. KANAMORI, N. HARA (<i>Japan</i>) Flood control operation and discharge warning system at Kusaki Dam	167
R. 15. B. L. CANTWELL, K. A. MURLEY (<i>Australia</i>) Design flood guidelines, Australia	187

	Page
R. 16. D. H. PILGRIM, I. A. ROWBOTTOM, G. L. WRIGHT (<i>Australia</i>) Estimation of spillway design floods for Australian dams	205
R. 17. G. LOMBARDI (<i>Suisse</i>) Analyse fréquentielle des crues - Distributions bornées	231
R. 18. B. DIEME, D. NEUHAUS, F. ZWAENEPOEL (<i>FRG</i>) Determination of the project and design floods for the Manantali Dam in Mali	259
R. 19. S. TAKASU, J. YAMAGUCHI (<i>Japan</i>) Principle for selecting type of spillway for flood control dams in Japan	279
R. 20. H. E. MINOR, R. SCHMIDIGER (<i>Switzerland</i>) Selection of spillway type giving special attention to safety aspects	305
R. 21. R. SINNIGER, P. L. BOURDEAU (<i>Switzerland</i>) Probability-based design of temporary diversions	319
R. 22. R. BIEDERMANN, P. DELLEY, K. FLURY, W. HAUENSTEIN, R. LAFFITE, G. LOMBARDI (<i>Switzerland</i>) Safety of Swiss dams against floods : design criteria and design flood	345
R. 23. D. VISCHER, P. RUTSCHMANN (<i>Switzerland</i>) Spillway facilities : typology and general safety questions	371
R. 24. C. H. KIM, W. S. AHN (<i>Korea</i>) A study on the abnormal flood control methods by multipurpose reservoir	383
R. 25. W. LEE (<i>Korea</i>) Analytical assessment on the design flood and flood control rule of dams in the Han River Basin, Korea	393
R. 26. J. SONU (<i>Korea</i>) Development of rainfall-runoff model for small watershed and parameter optimization	409
R. 27. Y. N. YOON, B. H. SEOH (<i>Korea</i>) Design and application of the flood forecasting system for the Nakdong River Basin	425
R. 28. N. R. SAELTHUN (<i>Norway</i>) Norwegian procedures for flood estimation	437
R. 29. J. M. A. SANTA CLARA (<i>Zimbabwe</i>) The hydrological operation of the Kariba hydroelectric scheme : past, present and future	449
R. 30. T. C. KABELL (<i>Zimbabwe</i>) The assessment of design flood parameters in Zimbabwe	479
R. 31. S. BOONPIRAKS, P. RATNARATHORN, K. KULKANJANA-TORN (<i>Thailand</i>) Reservoir operation of Ubol Ratana Dam after improvement	493
R. 32. K. SINDHVANANDA, K. NAPARAXAWONG, C. SWATDIRURK (<i>Thailand</i>) Pre and post-dam flood characteristics of Ubol Ratana dam	507

	Page
R. 33. S. CHAMPA, B. MAHATHARADOL, A. SUTHINSAK (<i>Thailand</i>) Spillway operation of Srinagarind Dam and Khao Laem Dam	521
R. 34. A. SVEEN, D. K. LYSNE, L. E. PETTERSON (<i>Norway</i>) Design of supplementary spillway	537
R. 35. G. R. POWLEDGE, D. L. SVEUM (<i>USA</i>) Overtopping embankment dams - An alternative in accommodating rare floods?	555
R. 36. J. J. CASSIDY, D. B. CHERRY, S. L. HUI, J. E. WELTON (<i>USA</i>) Consideration with regard to the choice of recurrence interval for a design flood	583
R. 37. N. F. PARRETT (<i>USA</i>) Decision process elements to selecting solutions for hydrologic deficiencies at existing dams	605
R. 38. H. E. KARBS (<i>USA</i>) Grapevine dam spillway modification	629
R. 39. B. H. WANG (<i>USA</i>) Determination of design flood for spillways	647
R. 40. K. FUJIMOTO, A. MORITANI (<i>Japan</i>) Flood control through dam and reservoirs with small catchment area in Japan	667
R. 41. D. STEPHENSON, S. T. COLLINS (<i>South Africa</i>) Problems due to inaccurate flood estimates at Collywobblers	691
R. 42. V. BROZA (<i>Tchécoslovaquie</i>) Dimensionnement des évacuateurs de crue des barrages. Pratique actuelle, expériences d'exploitation. Idées nouvelles	701
R. 43. N. CASTILLEJO, T. SEMELER (<i>Venezuela</i>) Determination of construction flood for Macagua Project	711
R. 44. N. CASTILLEJO, A. MARCANO (<i>Venezuela</i>) Operation of Guri Dam spillway during raising of the dam	727
R. 45. A. MARCANO, A. PATINO, C. CASTRO (<i>Venezuela</i>) Selection of the energy dissipators for the spillways of Lower Caroni Projects	745
R. 46. K. A. FERGUSON, J. W. FRANCE (<i>USA</i>) Selection of spillway design floods based on an incremental damage assessment (IDA)	769
R. 47. SOEDIBYO (<i>Indonesia</i>) Unpredicted high flood : case histories at Mrica Hepp	787
R. 48. S. SOERACHMAD (<i>Indonesia</i>) Mrica Dam, Indonesia - Criteria for choice of spillways	799
R. 49. C. D. SOEMARTO (<i>Indonesia</i>) Design flood for Depok flood control dam	815
R. 50. H. REBAGLIATI, A. SANCHEZ GUZMAN, C. M. FIGUEROA (<i>Argentina</i>) Review of design criteria of diversion flood in Piedra del Aguila project	837

	Page
R. 51. J. D. GOSDEN (<i>Great Britain</i>) The role of two dams in a flood alleviation scheme in Malaysia ..	861
R. 52. P. A. A. BACK, D. L. WILDEN (<i>Great Britain</i>) Automatic flood routing at Victoria Dam, Sri Lanka	879
R. 53. M. F. KENNARD, K. T. BASS (<i>Great Britain</i>) Determination of design flood and its application to existing dams	897
R. 54. R. W. CARSON, M. J. NOZDRYN-PLOTNICKI, B. W. KORBAYLO (<i>Canada</i>) Flood studies of the Nelson River	913
R. 55. W. K. SHENOUDA (<i>Egypt</i>) Design floods in Egyptian Dams and Barrages	929
R. 56. K. RYTTERS (<i>Sweden</i>) The Mrica spillways	939
R. 57. P. H. REITER (<i>Finland</i>) Experience in design flood analysis of dams in Finland (Example : The Kokemäenjoki river in southwestern Finland)	951
R. 58. M. KIVIJARVI, P. H. REITER (<i>Finland</i>) The interactive, dynamic river management computer model of Kemijoki river and its use for optimizing and safeguarding operations under extraordinary flood conditions	975
R. 59. P. H. REITER (<i>Finland</i>) Numerical model simulations of dam operation under extraordi- nary flood conditions	995
R. 60. D. DUBAND, C. MICHEL, H. GARROS, J. ASTIER (<i>France</i>) Evaluation des crues extrêmes et de la crue de projet par la méthode du Gradex	1009
R. 61. G. ENFORS, J. EURENIUS (<i>Sweden</i>) The Ore River, Sweden. Consequences of unpredicted high floods	1049
R. 62. A. D. MOHILE, S. N. KATHURIA (<i>India</i>) Design flood studies for Indira Sarovar (Bodhghat) hydroelectric project	1063
R. 63. J. F. MISTRY, M. U. PUROHIT, T. V. K. MURTHY, K. J. MODI (<i>India</i>) Estimation of disastrous flood at Macchu Dam-II on August 11-12, 1979 and revised design flood for its restoration	1077
R. 64. J. L. GUITART, C. GOMEZ-CAFFARENA (<i>Spain</i>) Determination of floods by statistical methods	1089
R. 65. J. DELGADO GARCIA (<i>Spain</i>) Basic criteria for sizing large dam spillways	1093
R. 66. J. L. BARRACHINA, L. M. BLASCO (<i>Spain</i>) An unpredicted high flood at La Baells Dam on the 7th and 8th November 1982	1107
R. 67. S. BERGSTROM, P. E. OHLSSON (<i>Sweden</i>) Towards new guidelines on spillway design in Sweden	1121

	Page
R. 68. B. C. V. KARTHA (<i>Canada</i>) Derivation of design floods for hydro projects in Pacific Canada	1133
R. 69. A. M. MELONE, C. D. SELLARS (<i>Canada</i>) Re-evaluation of design floods thirty years after dam construction	1157
R. 70. Ch. GUILLAUD (<i>Canada</i>) La détermination de la crue de projet : les principes et leur application	1177
R. 71. G. PERSSON, B. BERGANDER (<i>Sweden</i>) Siphon outlet for emergency discharge at Ljusnefors hydro power plant, Sweden	1197
R. 72. M. J. TAYLOR (<i>South Africa</i>) Oxkraal Dam - Determination of risk due to construction flood ..	1211
R. 73. W. J. R. ALEXANDER, Z. P. KOVACS (<i>South Africa</i>) Lessons learnt from exceptional floods in southern Africa	1223
R. 74. R. L. SCHULMAN, H. W. KRAUCH, J. MORAES ZALESKI, A. SZPILMAN, W. M. EMERSON, C. PIASENTIN (<i>Paraguay</i>) Itaipu project spillway behaviour during the maximum recorded flood	1239
R. 75. F. GIJON (<i>Spain</i>) The evacuation of floods during the operation of reservoirs	1261
R. 76. A. PASTOR TURULLOLS (<i>Spain</i>) The Yeguas Dam spillway	1285
R. 77. J. CAJETE BALTAR, J. L. BLANCO SEOANE (<i>Spain</i>) Spillway dimensioning revision - Modifications in Plandescun and San Esteban Dams	1307
R. 78. J. C. MILLET, J. CHAMBON, G. SOYER, C. LEFEVRE (<i>France</i>) Augmentation de la capacité des ouvrages d'évacuation de divers barrages	1325
R. 79. J. LECORNU, N. BORDIEC, P. TOURASSE, G. CHARRETON, L. GRAND, J.-P. DUBEL, J.-M. DUJARDIN (<i>France</i>) Exemples de prise en compte de l'annonce des crues dans la conception et l'exploitation de barrages français	1349
R. 80. W. H. HAGER, R. SINNIGER (<i>Switzerland</i>) Reservoir storage effect on design flood	1376
R. 81. F. VERNI (<i>Chili</i>) Hydrologic analysis of the storm affecting the central zone of Chile in June 1986	1401
R. 82. D. MRIOUAH (<i>Maroc</i>) Crues importantes imprévues : cas du barrage de Oued El Makha-zine au Maroc	1419
R. 83. A. EDDIANI (<i>Maroc</i>) Crue de projet et maîtrise des crues au futur barrage de M'Jara ..	1429
R. 84. P. G. MACKEY (<i>Great Britain</i>) Derwent valley and Ladybower Dams. Flood accommodation works and raising to meet probable maximum flood	1455

	Page
R. 85. R. WIDMANN (<i>Austria</i>) Influence of Alpine reservoirs on flood discharge	1471
R. 86. P. RISSLER (<i>FRG</i>) Outlet size and success of erosion management	1485
R. 87. G. STEVANELLA (<i>Italy</i>) Evaluation of waves due to landslides	1501
R. 88. J. PAN, W. TENG (<i>China</i>) Determination of design flood in China	1515
R. 89. J. KÖNGETER (<i>FRG</i>) Erodible dams as fuse plug spillway. Guacerique Dam (Honduras) and Koudiat Aftren Dam (Algeria) are demonstrated as examples	1529
R. 90. G. A. DEVOTO, R. A. MANZANO, I. L. OBERTELLO, R. S. SEOANE (<i>Argentina</i>) Probable maximum flood for the design of Piedra del Aguila Project	1543
R. 91. A. LARA (<i>Argentina</i>) Flood control versus energy production in Yacyreta - An optimi- zation case	1561
R. 92. A. LARA, N. BADANO, J. LINDELL (<i>Argentina</i>) Design flood and control structures for Yacyreta hydroelectric scheme	1573
R. 93. V. M. SEMENKOV, B. G. KARTELEV, G. L. RUBINSTEIN (<i>USSR</i>) (*) Passage of water during construction and operation of hydro projects comprising large dams	1593
R. 94. A. MILLA, A. PEDRERO, J. A. HERRERAS (<i>Spain</i>) (*) The automatic flood forecast and warning system in Spain	1609
General Report/ <i>Rapport Général Q 63</i>	1621

(*) Late papers/*Rapports non examinés par le Rapporteur Général.*